User's
Manual

DPharp EJX™

EJX910A and EJX930A
Fieldbus Communication Type

IM 01C25R03-01E

vigilantplant.®

DPharp
FOR THE DIGITAL WORLD

YOKOGAWA
Yokogawa Electric Corporation

IM 01C25R03-01E
6th Edition

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REVISION RECORD

1. INTRODUCTION

This manual is for the DPharp EJX Multivariable Transmitter Fieldbus Communication Type. The Fieldbus communication type is based on the same silicon resonant sensing technology used in the HART communication type, and is similar to the communication types in terms of basic performance and operation. This manual describes only those topics that are required for operation of the Fieldbus communication type. For information on the installation, wiring, and maintenance of EJX series pressure transmitters, refer to the user's manual for each model.

■ Regarding This Manual

- This manual should be passed on to the end user.
- The contents of this manual are subject to change without prior notice.
- All rights reserved. No part of this manual may be reproduced in any form without Yokogawa's written permission.
- Yokogawa makes no warranty of any kind with regard to this manual, including, but not limited to, implied warranty of merchantability and fitness for a particular purpose.
- If any question arises or errors are found, or if any information is missing from this manual, please inform the nearest Yokogawa sales office.
- The specifications covered by this manual are limited to those for the standard type under the specified model number break-down and do not cover custom-made instruments.
- Please note that changes in the specifications, construction, or component parts of the instrument may not immediately be reflected in this manual at the time of change, provided that postponement of revisions will not cause difficulty to the user from a functional or performance standpoint.
- The following safety symbols are used in this manual:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

IMPORTANT

Indicates that operating the hardware or software in this manner may damage it or lead to system failure.

NOTE

Draws attention to information essential for understanding the operation and features.

1.1 Safe Use of This Product

For the safety of the operator and to protect the instrument and the system, please be sure to follow this manual's safety instructions when handling this instrument. If these instructions are not heeded, the protection provided by this instrument may be impaired. In this case, Yokogawa cannot guarantee that the instrument can be safely operated. Please pay special attention to the following points:

(a) Installation

- This instrument may only be installed by an engineer or technician who has an expert knowledge of this device. Operators are not allowed to carry out installation unless they meet this condition.

- With high process temperatures, care must be taken not to burn yourself by touching the instrument or its casing.

- Never loosen the process connector nuts when the instrument is installed in a process. This can lead to a sudden, explosive release of process fluids.

- When draining condensate from the pressure detector section, take appropriate precautions to prevent the inhalation of harmful vapors and the contact of toxic process fluids with the skin or eyes.

- When removing the instrument from a hazardous process, avoid contact with the fluid and the interior of the meter.

- All installation work shall comply with local installation requirements and the local electrical code.

(b) Wiring

- The instrument must be installed by an engineer or technician who has an expert knowledge of this instrument. Operators are not permitted to carry out wiring unless they meet this condition.

- Before connecting the power cables, please confirm that there is no current flowing through the cables and that the power supply to the instrument is switched off.

(c) Operation

- Wait 5 min. after the power is turned off, before opening the covers.

(d) Maintenance

- Please carry out only the maintenance procedures described in this manual. If you require further assistance, please contact the nearest Yokogawa office.

- Care should be taken to prevent the build up of dust or other materials on the display glass and the name plate. To clean these surfaces, use a soft, dry cloth.

(e) Explosion Protected Type Instrument

- Users of explosion proof instruments should refer first to section 2.1 (Installation of an Explosion Protected Instrument) of this manual.

- The use of this instrument is restricted to those who have received appropriate training in the device.

- Take care not to create sparks when accessing the instrument or peripheral devices in a hazardous location.

(f) Modification

- Yokogawa will not be liable for malfunctions or damage resulting from any modification made to this instrument by the customer.

1.2 Warranty

- The warranty shall cover the period noted on the quotation presented to the purchaser at the time of purchase. Problems occurring during the warranty period shall basically be repaired free of charge.

- If any problems are experienced with this instrument, the customer should contact the Yokogawa representative from which this instrument was purchased or the nearest Yokogawa office.

- If a problem arises with this instrument, please inform us of the nature of the problem and the circumstances under which it developed, including the model specification and serial number. Any diagrams, data and other information you can include in your communication will also be helpful.

- The party responsible for the cost of fixing the problem shall be determined by Yokogawa following an investigation conducted by Yokogawa.

- The purchaser shall bear the responsibility for repair costs, even during the warranty period, if the malfunction is due to:

  - Improper and/or inadequate maintenance by the purchaser.
  - Malfunction or damage due to a failure to handle, use, or store the instrument in accordance with the design specifications.
  - Use of the product in question in a location not conforming to the standards specified by Yokogawa, or due to improper maintenance of the installation location.
  - Failure or damage due to modification or repair by any party except Yokogawa or an approved representative of Yokogawa.
  - Malfunction or damage from improper relocation of the product in question after delivery.
  - Reason of force majeure such as fires, earthquakes, storms/floods, thunder/lightening, or other natural disasters, or disturbances, riots, warfare, or radioactive contamination.

1.3 ATEX Documentation

This is only applicable to the countries in European Union.

GB

All instruction manuals for ATEX Ex related products are available in English, German and French. Should you require Ex related instructions in your local language, you are to contact your nearest Yokogawa office or representative.

DK

Alle brugervejledninger for produkter relateret til ATEX Ex er tilgængelige på engelsk, tysk og fransk. Skulle De ønske yderligere oplysninger om håndtering af Ex produkter på eget sprog, kan De rette henvendelse herom til den nærmeste Yokogawa afdeling eller forhandler.

I

Tutti i manuali operativi di prodotti ATEX contrassegnati con Ex sono disponibili in inglese, tedesco e francese. Se si desidera ricevere i manuali operativi di prodotti Ex in lingua locale, mettersi in contatto con l'ufficio Yokogawa più vicino o con un rappresentante.

E

Todos los manuales de instrucciones para los productos antiexplosivos de ATEX están disponibles en inglés, alemán y francés. Si desea solicitar las instrucciones de estos artículos antiexplosivos en su idioma local, deberá ponerse en contacto con la oficina o el representante de Yokogawa más cercano.

NL

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SF

Kaikkien ATEX Ex -tyyppisten tuotteiden käyttöhjeet ovat saatavilla englannin-, saksan- ja ranskankielisinä. Mikäli tarvitsette Ex -tyyppisten tuotteiden ohjeita omalla paikallisella kielellännne, ottakaa yhteyttä lähimpään Yokogawa-toimistoon tai -edustajaan.

P

Todos os manuais de instruções referentes aos produtos Ex da ATEX estão disponíveis em Inglês, Alemão e Francês. Se necessitar de instruções na sua língua relacionadas com produtos Ex, deverá entrar em contacto com a delegação mais próxima ou com um representante da Yokogawa.

F

Tous les manuels d'instruction des produits ATEX Ex sont disponibles en langue anglaise, allemande et française. Si vous nécessitez des instructions relatives aux produits Ex dans votre langue, veuillez bien contacter votre représentant Yokogawa le plus proche.

D

Alle Betriebsanleitungen für ATEX Ex bezogene Produkte stehen in den Sprachen Englisch, Deutsch und Französisch zur Verfügung. Sollten Sie die Betriebsanleitungen für Ex-Produkte in Ihrer Landessprache benötigen, setzen Sie sich bitte mit Ihrem örtlichen Yokogawa-Vertreter in Verbindung.

S

Alla instruktionsböcker för ATEX Ex (explosionssäkra) produkter är tillgängliga på engelska, tyska och franska. Om Ni behöver instruktioner för dessa explosionssäkra produkter på annat språk, skall Ni kontakta närmaste Yokogawakontor eller representant.

GR

Ολα τα εγχειρίδια λειτονργίας των προϊόντων με ATEX Ex διατίθενται στα Αγγλικά, Γερμανικά και Γαλλικά. Σε περίπτωση που χρειάζεστε οδηγίες σχετικά με Ex στην τοπική γλώσσα παρακαλούμε επικοινωνήστε με το πλησιέστερο γραφείο της Yokogawa ή αντιπρόσωπο της.

SK

Všetky návody na obsluhu pre prístroje s ATEX Ex sú k dispozícii v jazyku anglickom, nemeckom a francúzskom. V prípade potreby návodu pre Ex-prístroje vo Vašom národnom jazyku, skontaktujte prosím miestnu kanceláriu firmy Yokogawa.

CZ

Všechny uživatelské příručky pro výrobky, na něž se vztahuje nevýbušné schválení ATEX Ex, jsou dostupné v angličtině, němčině a francouzštině. Požadujete-li pokyny týkající se výrobků s nevýbušným schválením ve vašem lokálním jazyku, kontaktujte prosím vaši nejbližší reprezentační kancelář Yokogawa.

LT

Visos gaminiø ATEX Ex kategorijos Eksploatavimo instrukcijos teikiami anglø, vokieèiø ir prancûzø kalbomis. Norëdami gauti prietaisø Ex dokumentacijà kitomis kalbomis susisiekite su artimiausiu bendrovës "Yokogawa" biuru arba atstovu.

LV

Visas ATEX Ex kategorijas izstrâdâjumu Lietoðanas instrukcijas tiek piegâdâtas angïu, vâcu un franèu valodâs. Ja vçlaties saòemt Ex ierîèu dokumentâciju citâ valodâ, Jums ir jâsazinâs ar firmas Jokogava (Yokogawa) tuvâko ofisu vai pârstâvi.

EST

Kõik ATEX Ex toodete kasutamisjuhendid on esitatud inglise, saksa ja prantsuse keeles. Ex seadmete muukeelse dokumentatsiooni saamiseks pöörduge lähima Iokagava (Yokogawa) kontori või esindaja poole.

PL

Wszystkie instrukcje obsługi dla urządzeń w wykonaniu przeciwwybuchowym Ex, zgodnych z wymaganiami ATEX, dostępne są w języku angielskim, niemieckim i francuskim. Jeżeli wymagana jest instrukcja obsługi w Państwa lokalnym ję zyku, prosimy o kontakt z najbliższym biurem Yokogawy.

SLO

Vsi predpisi in navodila za ATEX Ex sorodni pridelki so pri roki v angliščini, nemščini ter francoščini. Èe so Ex sorodna navodila potrebna v vašem tukejnjem jeziku, kontaktirajte vaš najbliši Yokogawa office ili predstaunika.

H

Az ATEX Ex mûszerek gépkönyveit angol, német és francia nyelven adjuk ki. Amennyiben helyi nyelven kérik az Ex eszközök leírásait, kérjük keressék fel a legközelebbi Yokogawa irodát, vagy képviseletet.

BG

Всички упътвания за продукти от серията ATEX Ex се предлагат на английски, немски и френски език. Ако се нуждаете от упътвания за продукти от серията Ex на родния ви език, се свържете с най-близкия офис или представителство на фирма Yokogawa.

RO

Toate manualele de instructiuni pentru produsele ATEX Ex sunt in limba engleza, germana si franceza. In cazul in care doriti instructiunile in limba locala, trebuie sa contactati cel mai apropiat birou sau reprezentant Yokogawa.

M

Il-manwali kollha ta' l-istruzzjonijiet għal prodotti marbuta ma' ATEX Ex huma disponibbli bl-Ingliż, bil-Ġermaniż u bil-Franċiż. Jekk tkun teħtieġ struzzjonijiet marbuta ma' Ex fil-lingwa lokali tiegħek, għandek tikkuntattja lill-eqreb rappreżentan jew uffiċċju ta' Yokogawa.

2. HANDLING CAUTIONS

2.1 Installation of an Explosion-Protected Instrument

If a customer makes a repair or modification to an intrinsically safe or explosionproof instrument and the instrument is not restored to its original condition, its intrinsically safe or explosionproof construction may be compromised and the instrument may be hazardous to operate. Please contact Yokogawa before making any repair or modification to an instrument.

CAUTION

This instrument has been tested and certified as being intrinsically safe or explosionproof. Please note that severe restrictions apply to this instrument's construction, installation, external wiring, maintenance and repair. A failure to abide by these restrictions could make the instrument a hazard to operate.

WARNING

Maintaining the safety of explosionproof equipment requires great care during mounting, wiring, and piping. Safety requirements also place restrictions on maintenance and repair. Please read the following sections very carefully.

WARNING

The range setting switch must not be used in a hazardous area.

2.1.1 FM approval

a. FM Explosionproof Type

Caution for FM Explosionproof type

Note 1. EJX multivariable transmitter with optional code /FF1 is applicable for use in hazardous locations:
- Applicable Standard: FM3600, FM3615, FM3810, ANSI/NEMA 250
- Explosionproof for Class I, Division 1, Groups B, C and D.
- Dust-ignitionproof for Class II/III, Division 1, Groups E, F and G.
- Enclosure rating: NEMA 4X.
- Temperature Class: T6
- Ambient Temperature: –40 to 60°C
- Supply Voltage: 32V dc max.
- Current Draw: 15 mA dc

Note 2. Wiring
- All wiring shall comply with National Electrical Code ANSI/NFPA70 and Local Electrical Codes.
- When installed in Division 1, "FACTORY SEALED, CONDUIT SEAL NOT REQUIRED."

Note 3. Operation
- Keep the "WARNING" nameplate attached to the transmitter.
  WARNING: OPEN CIRCUIT BEFORE REMOVING COVER. FACTORY SEALED, CONDUIT SEAL NOT REQUIRED. INSTALL IN ACCORDANCE WITH THE USERS MANUAL IM 01C25.
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in a hazardous location.

Note 4. Maintenance and Repair
- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation is prohibited and will void Factory Mutual Explosionproof Approval.

b. FM Intrinsically safe and Nonincendive Type

EJX multivariable transmitter with optional code / FS15.

- Applicable standard: FM3600, FM3610, FM3611, FM3810, ANSI/NEMA250, IEC60079-27
- FM Intrinsically Safe Approval

  [Entity Model]

  Class I, II & III, Division 1, Groups A, B, C, D, F & G, Temperature Class T4 Ta=60°C, Type 4X and Class I, Zone 0, AEx ia IIC, Temperature Class T4 Ta=60°C, Type 4X

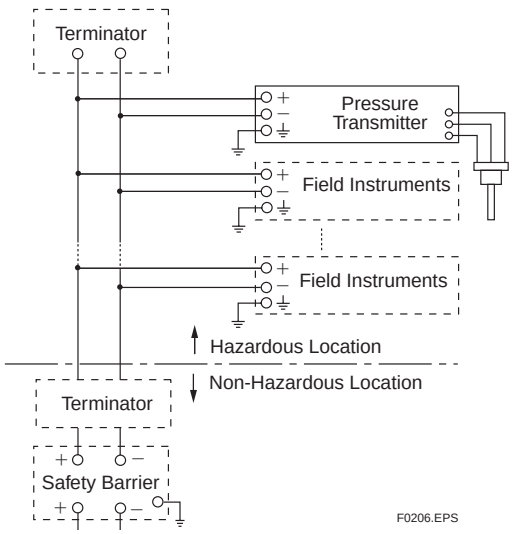
  [FISCO Model]

  Class I, II & III, Division 1, Groups A, B, C, D, F & G, Temperature Class T4 Ta=60°C, Type 4X and Class I, Zone 0, AEx ia IIC, Temperature Class T4 Ta=60°C, Type 4X
- Nonincendive Approval

  Class I, Division 2, Groups A, B, C & D Temperature Class T4 Ta=60°C, Type 4X and Class II, Division 2, Groups F & G Temperature Class T4 Ta=60°C, Type 4X and Class I, Zone 2, Group IIC, Temperature Class T4 Ta=60°C, Type 4X and Class III, Division 1, Temperature Class T4 Ta=60°C, Type 4X
- Electrical Connection: 1/2 NPT female, M20 female
- Caution for FM Intrinsically safe type. (Following contents refer to “DOC. No. IFM026-A12 p.1 to p.4.”)

■ IFM026-A12

● Installation Diagram for Intrinsically safe (Division 1 Installation)



Note 1. Barrier must be installed in an enclosure that meets the requirements of ANSI/ISA 61010-1.

Note 2. Control equipment connected to the Associated Apparatus must not use or generate more than 250 Vrms or Vdc.

Note 3. Installation should be in accordance with ANSI/ISA 12.06.01 “Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations” and the National Electrical Code (ANSI/NFPA 70) Sections 504 and 505.

Note 4. The configuration of Associated Apparatus must be Factory Mutual Research Approved under FISCO Concept.

Note 5. Associated Apparatus manufacturer’s installation drawing must be followed when installing this equipment.

Note 6. No revision to drawing without prior Factory Mutual Research Approval.

Note 7. Terminator must be FM Approved.

Note 8. Note a warning label worded "SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY", and "INSTALL IN ACCORDANCE DOC.NO.IFM026-A12 P.1 TO 4."

Electrical Data:

- Rating 1 (Entity)

  For Groups A, B, C, D, F, and G or Group IIC
  Maximum Input Voltage Vmax: 24 V
  Maximum Input Current Imax: 250 mA
  Maximum Input Power Pmax: 1.2 W
  Maximum Internal Capacitance Ci: 3.52 nF
  Maximum Internal Inductance Li: 0 mH

or

- Rating 2 (FISCO)

  For Groups A, B, C, D, F, and G or Group IIC
  Maximum Input Voltage Vmax: 17.5 V
  Maximum Input Current Imax: 380 mA
  Maximum Input Power Pmax: 5.32 W
  Maximum Internal Capacitance Ci: 3.52 nF
  Maximum Internal Inductance Li: 0 mH

or

- Rating 3 (FISCO)

  For Groups C, D, F, and G or Group IIB
  Maximum Input Voltage Vmax: 17.5 V
  Maximum Input Current Imax: 460 mA
  Maximum Input Power Pmax: 5.32 W
  Maximum Internal Capacitance Ci: 3.52 nF
  Maximum Internal Inductance Li: 0 mH

Sensor Circuit: Uo=6.51 V, Io=4 mA, Po=6 mW, Co=34 μF, Lo=500 mH

Note: In the rating 1, the output current of the barrier must be limited by a resistor “Ra” such that Io=Uo/Ra. In the rating 2 or 3, the output characteristics of the barrier must be the type of trapezoid which are certified as the FISCO model (See “FISCO Rules”). The safety barrier may include a terminator. More than one field instruments may be connected to the power supply line.

● FISCO Rules

The FISCO Concept allows the interconnection of intrinsincally safe apparatus to associated apparatus not specifically examined in such combination. The criterion for such interconnection is that the voltage (Ui), the current (Ii) and the power (Pi) which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage (Uo, Voc, Vt), the current (Io, Isc, It) and the power (Po) which can be provided by the associated apparatus (supply unit).

$$Po \leqq Pi,\ Uo \leqq Ui,\ Io \leqq Ii$$

In addition, the maximum unprotected residual capacitance (Ci) and inductance (Li) of each apparatus (other than the terminators) connected to the fieldbus must be less than or equal to 5 nF and 10 μH respectively.

$$Ci \leqq 5nF,\ Li \leqq 10\mu H$$

In each I.S. fieldbus segment only one active source, normally the associated apparatus, is allowed to provide the necessary power for the fieldbus system. The allowed voltage(Uo, Voc,Vt) of the associated apparatus used to supply the bus cable must be limited to the range of 14 V dc to 17.5 V dc. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not allowed to provide energy to the system, except to a leakage current of 50 μA for each connected device.

Supply unit

Trapezoidal or rectangular output characteristic only

Uo = 14...17.5 V (I.S. maximum value)

Io according to spark test result or other assessment.
No specification of *Lo* and *Co* is required on the certificate or label.

Cable

The cable used to interconnect the devices needs to comply with the following parameters:

Loop resistance *R'*: 15...150 Ω/km
Inductance per unit length *L'*: 0.4...1 mH/km
Capacitance per unit length *C'*: 45...200 nF/km.
C'=C' line/line + 0.5 C' line/screen, if both lines are floating or C'=C' line/line + C' line/screen, if the screen is connected to one line.
Length of spur cable: max. 60 m
Length of trunk cable: max. 1 km (Group IIC) or 5 km (Group IIB)
Length of splice : max.1m

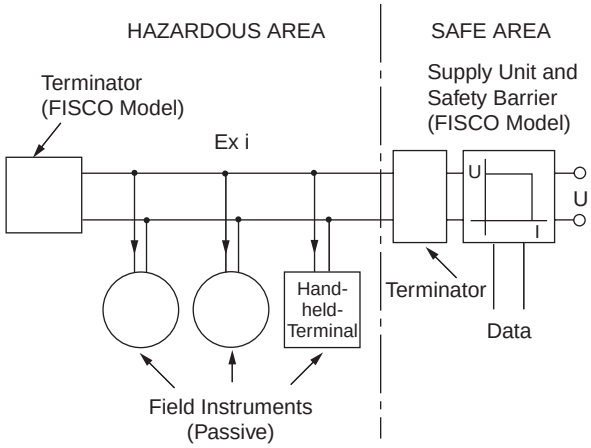
Terminators

At each end of the trunk cable an FM approved line terminator with the following parameters is suitable:

R = 90...100 Ω
C = 0...2.2 mF

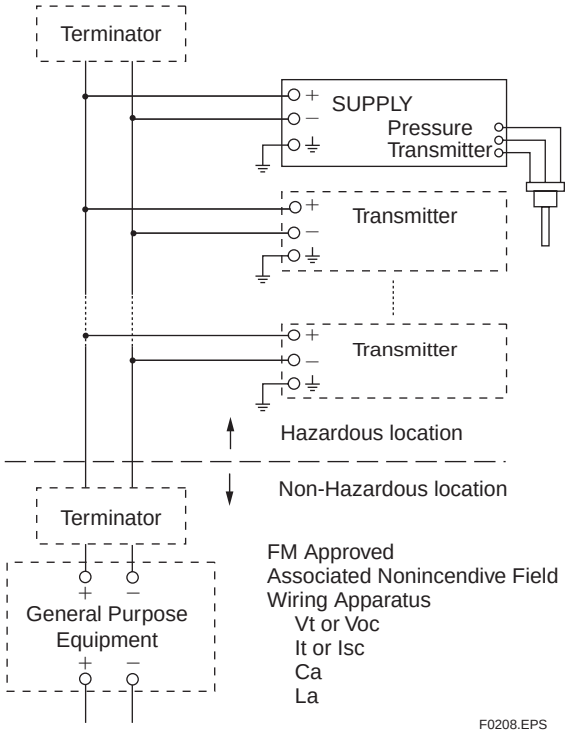
System evaluations

The number of passive device like transmitters, actuators, hand held terminals connected to a single bus segment is not limited due to I.S. reasons. Furthermore, if the above rules are respected, the inductance and capacitance of the cable need not to be considered and will not impair the intrinsic safety of the installation.



I.S. fieldbus system complying with FISCO model

● Installation Diagram for Nonincendive (Division 2 Installation)



Note 1. Installation should be in accordance with the National Electrical Code ® (ANSI/NFPA 70) Article 500.
Note 2. The configuration of Associated Nonincendive Field Wiring Apparatus must be FM Approved.
Note 3. Approved under FNICO Concept.
Note 4. Dust-tight conduit seal must be used when installed in Class II and Class III environments.
Note 5. Associated Apparatus manufacturer's installation drawing must be followed when installing this apparatus.
Note 6. No revision to drawing without prior FM Approvals.
Note 7. Terminator must be FM Approved.
Note 8. The nonincendive field wiring circuit concept allows interconection of nonincendive field wiring apparatus with associated nonincendive field wiring apparatus, using any of the wiring methods permitted for unclassified locations.
Note 9. Installation requirements;
Vmax ≧ Voc or Vt
Imax = see note 10.
Ca ≧ Ci + Ccable
La ≧ Li + Lcable
Note 10. For this current controlled circuit, the parameter (Imax) is not required and need not be aligned with parameter (Isc) of the barrier or associated nonincendive field wiring apparatus.
Note 11. If ordinary location wiring methods are used, the transmitter shall be connected to FM Approved associated non-incendive field wiring apparatus.

Electrical data:
Vmax: 32V
Ci:1.76 nF
Li: 0 μH

● FNICO Rules

The FNICO Concept allows the interconnection of nonincendive field wiring apparatus to associated nonincendive field wiring apparatus not specifically examined in such combination. The criterion for such interconnection is that the voltage (Vmax), the current (Imax) and the power (Pmax) which nonincendive field wiring apparatus can receive and remain nonincendive, considering faults, must be equal or greater than the voltage (Uo, Voc or Vt), the current (Io, Isc or It) and the power (Po) which can be provided by the associated nonincendive field wiring apparatus (supply unit). In addition the maximum unprotected residual capacitance (Ci) and inductance (Li) of each apparatus (other than terminators) connected to the Fieldbus must be less than or equal to 5nF and 20uH respectively.

In each N.I. Fieldbus segment only one active source, normally the associated nonincendive field wiring apparatus, is allowed to provide the necessary power for the Fieldbus system. The allowed voltage (Uo, Voc or Vt) of the associated nonincendive field wiring apparatus used to supply the bus cable must be limited to the range 14Vdc to 17.5Vdc. All other equipment connected to the bus cable has to be passive, meaning that the apparatus is not allowed to provide energy to the system, except a leakage current of 50 μA for each connected device. Separately powered equipment needs galvanic isolation to ensure the nonincendive field wiring Fieldbus circuit remains passive.

Cable

The cable used to interconnect the devices needs to comply with the following parameters:

Loop resistance *R'*: 15...150 Ω/km
Inductance per unit length *L'*: 0.4...1 mH/km
Capacitance per unit length C': 45....200 nF/km
C' =C' line/line+0.5 C' line/screen, if both lines are floating or C' = C' line/line + C'line/screen, if the screen is connected to one line.
Length of spur cable: max. 60 m
Length of trunk cable: max. 1 km (Group IIC) or 5 km (Group IIB)
Length of splice: max = 1 m

Terminators

At the end of each trunk cable an FM Approved line terminator with the following parameters is suitable:

R= 90...100 Ω
C = 0 ....2.2 uF

2.1.2 CSA Certification

a. CSA Explosionproof Type

Caution for CSA explosionproof type.

Note 1. EJX multivariable transmitter with optional code /CF1 is applicable for use in hazardous locations:

Certificate: 2014354
- Applicable Standard: C22.2 No.0, C22.2 No.0.4, C22.2 No.0.5, C22.2 No.25, C22.2 No.30, C22.2 No.94, C22.2 No.61010.1-01, C22.2 No.60079-0, C22.2 No.60079-1

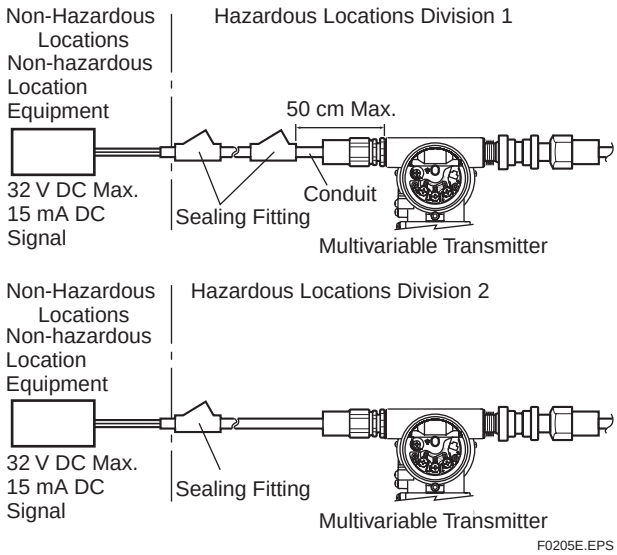
[For CSA C22.2]
- Explosion-proof for Class I, Groups B, C and D.
- Dustignition-proof for Class II/III, Groups E, F and G.
- Enclosure: TYPE 4X
- Temperature Code: T6...T4

[For CSA E60079]
- Flameproof for Zone 1, Ex d IIC T6...T4
- Enclosure: IP66 and IP67
- Maximum Process Temperature: 120°C (T4), 100°C (T5), 85°C (T6)
- Ambient Temperature: –50 to 75°C (T4), –50 to 80°C (T5), –50 to 72°C (T6)
- Supply Voltage: 32 V dc max.
- Output Signal: 15 mA dc

Note 2. Wiring
- All wiring shall comply with Canadian Electrical Code Part I and Local Electrical Codes.
- In hazardous location, wiring shall be in conduit as shown in the figure.
- WARNING:
  A SEAL SHALL BE INSTALLED WITHIN 50cm OF THE ENCLOSURE.
  UN SCELLEMENT DOIT ÊTRE INSTALLÉ À MOINS DE 50cm DU BOÎTIER.
- WARNING:
  WHEN INSTALLED IN CL.I, DIV 2, SEAL NOT REQUIRED.
  UNE FOIS INSTALLÉ DANS CL I, DIV 2, AUCUN JOINT N'EST REQUIS.

Note 3. Operation
- WARNING:
  AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.
  APRÉS POWER-OFF, ATTENDRE 5 MINUTES AVANT D'OUVRIR.
- WARNING:
  WHEN AMBIENT TEMPERATURE ≥ 65°C, USE THE HEAT-RESISTING CABLES ≥ 90°C.
  QUAND LA TEMPÉRATURE AMBIANTE ≥ 65°C, UTILISEZ DES CÂBLES RÉSISTANTES Á LA CHALEUR ≥ 90°C.
- Take care not to generate mechanical sparking when accessing to the instrument and peripheral devices in a hazardous location.

Note 4. Maintenance and Repair
- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation and Yokogawa Corporation of America is prohibited and will void Canadian Standards Explosionproof Certification.



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2.1.3 CENELEC ATEX Certification

(1) Technical Data

a. CENELEC ATEX (KEMA) Intrinsically Safe Type

Caution for CENELEC ATEX (KEMA) Intrinsically safe type.

Note 1. EJX multivariable transmitter with optional code /KS25 for potentially explosive atmospheres:
- No. KEMA 06ATEX0278 X
- Applicable Standard: EN 60079-0:2006, EN 50020:2002, EN 60079-27:2006, EN 50284:1999, EN 50281-1-1:1998

Note 2. Ratings
[Ex ia IIC T4]
Type of Protection and Marking Code:
Ex ia IIC T4
Group: II
Category: 1GD
Ambient Temperature: –40 to 60°C
Maximum Process Temperature (Tp.): 120°C
Maximum Surface Temperature for dust proof.
T85°C (Tamb.: –40°C to 60°C, Tp.: 80°C)
T100°C (Tamb.: –40°C to 60°C, Tp.: 100°C)
T120°C (Tamb.: –40°C to 60°C, Tp.: 120°C)
Degree of Protection of the Enclosure: IP66 and IP67
Electrical Data
- When combined with Trapezoidal output characteristic FISCO model IIC barrier

[Supply/Output circuit (terminals + and -)]
U_i = 17.5 V, I_i = 380 mA, P_i = 5.32 W,
C_i = 1.76 nF, L_i = 0 μH

[Temperature sensor circuit]
U_o = 7.63 V, I_o = 3.85 mA, P_o = 8 mW,
C_o = 4.8 μF, L_o = 100 mH

• When combined with Linear characteristic barrier

[Supply/Output circuit (terminals + and -)]
U_i = 24.0 V, I_i = 250 mA, P_i = 1.2 W,
C_i = 1.76 nF, L_i = 0 μH

[Temperature sensor circuit]
U_o = 7.63 V, I_o = 3.85 mA, P_o = 8 mW,
C_o = 4.8 μF, L_o = 100 mH

[Ex ia IIB T4]
Type of Protection and Marking Code:
Ex ia IIB T4
Group: II
Category: 1GD
Ambient Temperature: –40 to 60°C
Maximum Process Temperature (Tp.): 120°C
Maximum Surface Temperature for dust proof.
T85°C (Tamb.: –40°C to 60°C, Tp.: 80°C)
T100°C (Tamb.: –40°C to 60°C, Tp.: 100°C)
T120°C (Tamb.: –40°C to 60°C, Tp.: 120°C)
Degree of Protection of the Enclosure: IP66 and IP67
Electrical Data

• When combined with Trapezoidal output characteristic FISCO model IIB barrier

[Supply/Output circuit (terminals + and -)]
U_i = 17.5 V, I_i = 460 mA, P_i = 5.32 W,
C_i = 1.76 nF, L_i = 0 μH

[Temperatura sensor circuit]
U_o = 7.63 V, I_o = 3.85 mA, P_o = 8 mW,
C_o = 4.8 μF, L_o = 100 mH

Note 3. Installation
- All wiring shall comply with local installation requirements. (Refer to the installation diagram)

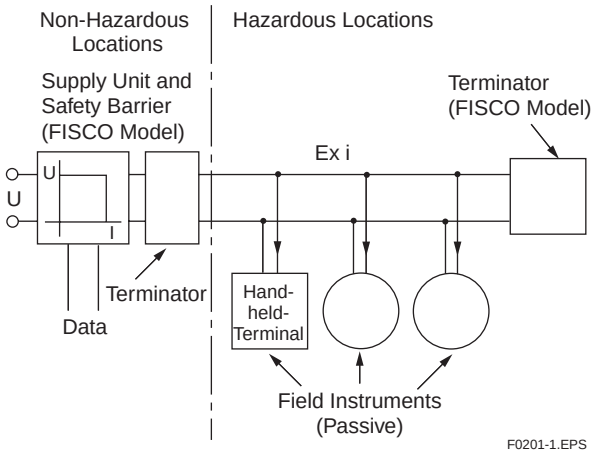
Note 4. Maintenance and Repair
- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation is prohibited and will void KEMA Intrinsically safe Certification.

Note 5. Special Conditions for Safe Use
- In the case where the enclosure of the Multivariable Transmitter is made of aluminium, if it is mounted in an area where the use of category 1 G apparatus is required, it must be installed such, that even in the event of rare incidents, ignition sources due to impact and friction sparks are excluded.

Note 6. Installation instructions
- The test voltage for the isolation between the intrincically safe supply/output circuit and the frame of the apparatas for Multivariable Transmitters that are provided with surge protection is limited to 90 V, due to the presence of the surge protection device only.

  When used in a potentially explosive atmosphere, requiring the use of apparatus of equipment category 1D or 2D, certified cable entry devices shall be used that are suitable for the application and correctly installed.

● FISCO Model



I.S. fieldbus system complying with FISCO

The criterion for such interconnection is that the voltage (U_i), the current (I_i) and the power (P_i), which intrinsically safe apparatus can receive, must be equal or greater than the voltage (U_o), the current (I_o) and the power (P_o) which can be provided by the associated apparatus (supply unit).

$P_o \leqq P_i$, $U_o \leqq U_i$, $I_o \leqq I_i$

In addition, the maximum unprotected residual capacitance (C_i) and inductance (L_i) of each apparatus (other than the terminators) connected to the fieldbus line must be equal or less than 5 nF and 10 μH respectively.

$C_i \leqq 5$ nF, $L_i \leqq 10\mu H$

Supply unit

The supply unit must be certified by a Notified body as FISCO model and following trapezoidal or rectangular output characteristic is used.

U_o = 14...17.5 V (I.S. maximum value)
Io based on spark test result or other assessment,

No specification of Lo and Co is required on the certificate or label.

Cable

The cable used to interconnect the devices needs to comply with the following parameters:

Loop resistance Rc: 15...150 Ω/km
Inductance per unit length Lc: 0.4...1 mH/km
Capacitance per unit length Cc: 45...200 nF/km
Length of spur cable: max. 60 m (IIC and IIB)
Length of trunk cable: max. 1 km (IIC) or 5 km (IIB)

Terminators

The terminator must be certified by a Notified body as FISCO model and at each end of the trunk cable an approved line terminator with the following parameters is suitable:

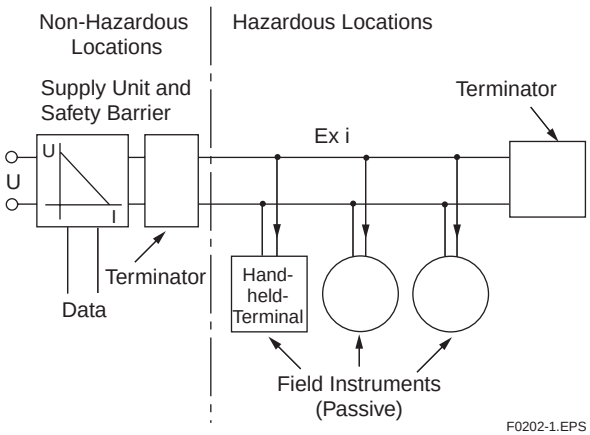
R = 90 . . . 102 Ω
C = 0 . . . 2.2 μF. (0.8...1.2 μF is required in operation)

The resistor must be infallible according to IEC 60079-11.

Number of Devices

The number of devices (max. 32) possible on a fieldbus link depends on factors such as the power consumption of each device, the type of cable used, use of repeaters, etc.

● Entity Model



I.S. fieldbus system complying with Entity model

I.S. values Power supply-field device:
Po ≦ Pi, Uo ≦ Ui, Io ≦ Ii
Calculation of max. allowed cable length:
Ccable ≦ Co - ∑Ci - ∑Ci (Terminator)
Lcable ≦ Lo - ∑Li

Number of Devices

The number of devices (max. 32) possible on a fieldbus link depends on factors such as the power consumption of each device, the type of cable used, use of repeaters, etc.

b. CENELEC ATEX (KEMA) Flameproof Type

Caution for CENELEC ATEX (KEMA) flameproof type

Note 1. EJX multivariable transmitter with optional code /KF21 for potentially explosive atmospheres:
- No. KEMA 07ATEX0109
- Applicable Standard: EN 60079-0:2006, EN 60079-1:2004, EN 61241-0:2006, EN 61241-1:2004
- Type of Protection and Marking Code: Ex d IIC T6...T4, Ex tD A21 IP6x T85, T100, T120
- Group: II
- Category: 2GD
- Temperature Class: T6, T5, and T4
- Enclosure: IP66 and IP67
- Ambient Temperature for gas-proof: –50 to 75°C (T6), –50 to 80°C (T5), and –50 to 75°C (T4)
- Maximum Process Temperature (Tp.) for gas-proof: 85°C (T6), 100°C (T5), and 120°C (T4)
- Maximum Surface Temperature for dust-proof: T85°C (Tamb.: –40 to 40°C, Tp.: 80°C) T100°C (Tamb.: –40 to 60°C, Tp.: 100°C) T120°C (Tamb.: –40 to 80°C, Tp.: 120°C)

Note 2. Electrical Data
- Supply voltage: 32 V dc max. Output current: 15 mA dc

Note 3. Installation
- All wiring shall comply with local installation requirements.
- The cable entry devices shall be of a certified flameproof type, suitable for the conditions of use.

Note 4. Operation
- Keep the “WARNING” label attached to the transmitter.
  WARNING: AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING. WHEN THE AMBIENT TEMP.≧65°C, USE HEAT-RESISTING CABLES≧90°C.
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in hazardous location.

Note 5. Maintenance and Repair

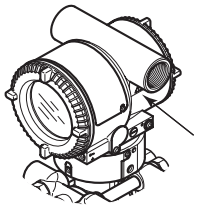
- The instrument modification or part replacement by other than an authorized representative of Yokogawa Electric Corporation is prohibited and will void KEMA Flameproof Certification.

(2) Electrical Connection

A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows.

Screw Size	Marking
ISO M20×1.5 female	⚠ M
ANSI 1/2 NPT female	⚠ A or ⚠ W

T0201.EPS



Location of the mark

F0201.EPS

(3) Installation

WARNING

- All wiring shall comply with local installation requirements and the local electrical code.
- There is no need for a conduit seal in Division 1 and Division 2 hazardous locations because this product is sealed at the factory.

(4) Operation

WARNING

- OPEN CIRCUIT BEFORE REMOVING COVER. INSTALL IN ACCORDANCE WITH THIS USER'S MANUAL
- Take care not to generate mechanical sparking when accessing the instrument and peripheral devices in a hazardous location.

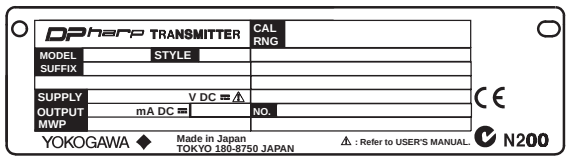
(5) Maintenance and Repair

WARNING

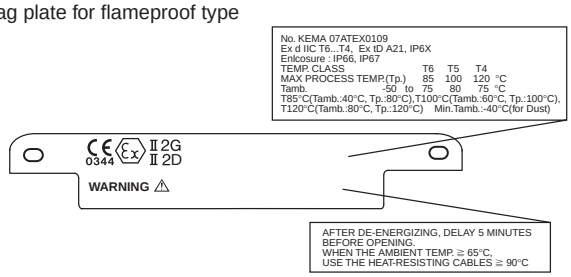
The instrument modification or part replacement by other than an authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

(6) Name Plate

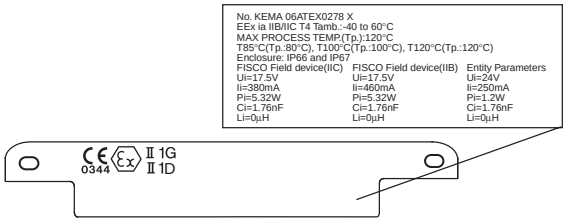
● Name plate



● Tag plate for flameproof type


No. KEMA 07ATEX0109
Ex d IIC T6...T4, Ex tD A21, IP6X
Enlcosure : IP66, IP67
TEMP. CLASS T6 T5 T4
MAX PROCESS TEMP.(Tp.) 85 100 120 °C
Tamb. -50 to 75 80 75 °C
T85°C(Tamb.:40°C, Tp.:80°C),T100°C(Tamb.:60°C, Tp.:100°C),
T120°C(Tamb.:80°C, Tp.:120°C) Min.Tamb.:-40°C(for Dust)
0344 II 2G II 2D
WARNING ⚠
AFTER DE-ENERGIZING, DELAY 5 MINUTES
BEFORE OPENING.
WHEN THE AMBIENT TEMP. ≧ 65°C,
USE THE HEAT-RESISTING CABLES ≧ 90°C

● Tag plate for intrinsically safe type


No. KEMA 06ATEX0278 X
EEx ia IIB/IIC T4 Tamb.:-40 to 60°C
MAX PROCESS TEMP.(Tp.):120°C
T85°C(Tp.:80°C), T100°C(Tp.:100°C), T120°C(Tp.:120°C)
Enclosure: IP66 and IP67
FISCO Field device(IIC) FISCO Field device(IIB) Entity Parameters
Ui=17.5V Ui=17.5V Ui=24V
Ii=380mA Ii=460mA Ii=250mA
Pi=5.32W Pi=5.32W Pi=1.2W
Ci=1.76nF Ci=1.76nF Ci=1.76nF
Li=0μH Li=0μH Li=0μH
0344 II 1G II 1D

F0202.EPS

MODEL: Specified model code.
STYLE: Style code.
SUFFIX: Specified suffix code.
SUPPLY: Supply voltage.
OUTPUT: Output signal.
MWP: Maximum working pressure.
CAL RNG: Specified calibration range.
NO.: Serial number and year of production*1.
YOKOGAWA ◆ TOKYO 180-8750 JAPAN: The manufacturer name and the address*2.

*1: The first digit in the final three numbers of the serial number appearing after "NO." on the name plate indicates the year of production. The following is an example of a serial number for a product that was produced in 2008:

12A819857 832

The year 2008

*2: "180-8750" is the Zip code for the following address.

2-9-32 Nakacho, Musashino-shi, Tokyo Japan

2.1.4 IECEx Certification

a. IECEx Flameproof Type

Caution for IECEx flameproof type.

Note 1. EJX multivariable transmitters with optional code /SF2 are applicable for use in hazardous locations:

- No. IECEx CSA 07.0008
- Applicable Standard: IEC60079-0:2004, IEC60079-1:2003
- Flameproof for Zone 1, Ex d IIC T6...T4
- Enclosure: IP66 and IP67
- Maximum Process Temperature: 120°C (T4), 100°C (T5), 85°C (T6)
- Ambient Temperature: –50 to 75°C (T4), –50 to 80°C (T5), –50 to 75°C (T6)
- Supply Voltage: 32 V dc max.
- Output Signal: 15 mA dc

Note 2. Wiring

- In hazardous locations, the cable entry devices shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.
- Unused apertures shall be closed with suitable flameproof certified blanking elements.

Note 3. Operation

- WARNING:
  AFTER DE-ENERGIZING, DELAY 5 MINUTES BEFORE OPENING.
- WARNING:
  WHEN AMBIENT TEMPERATURE ≥ 65°C, USE THE HEAT-RESISTING CABLES ≥ 90°C.
- Take care not to generate mechanical sparking when accessing to the instrument and peripheral devices in a hazardous location.

Note 4. Maintenance and Repair

- The instrument modification or parts replacement by other than authorized representative of Yokogawa Electric Corporation is prohibited and will void IECEx Certification.

3. ABOUT FIELDBUS

3.1 Outline

Fieldbus is a widely used bi-directional digital communication protocol for field devices that enable the simultaneous output to many types of data to the process control system.

The EJX multivariable transmitter Fieldbus communication type employs the specification standardized by The Fieldbus Foundation, and provides interoperability between Yokogawa devices and those produced by other manufacturers. Fieldbus comes with software consisting of five AI function blocks that enable the flexible implementation of systems.

For information on other features, engineering, design, construction work, startup and maintenance of Fieldbus, refer to “Fieldbus Technical Information” (TI 38K03A01-01E).

3.2 Internal Structure of EJX Multivariable Transmitter

The EJX Multivariable transmitter contains two virtual field devices (VFD) that share the following functions.

3.2.1 System/network Management VFD

- Sets node addresses and Physical Device tags (PD Tag) necessary for communication.
- Controls the execution of function blocks.
- Manages operation parameters and communication resources (Virtual Communication Relationship: VCR).

3.2.2 Function Block VFD

(1)Resource block

- Manages the status of EJX hardware.
- Automatically informs the host of any detected faults or other problems.

(2)SENSOR Transducer block

- Converts sensor output to pressure, static pressure, and capsule temperature signals, and transfers to the AI function blocks and flow transducer blok.

(3)FLOW Transducer block

- Accepts differential pressure, static pressure and external temperature data from the transducer block, calculates flow, and transfer to the AI function block.

(4)LCD Transducer block

- Controls the display of the integral indicator.

(5)AI function block

- Condition raw data from the Transducer block.
- Output differential pressure, static pressure and capsule temperature signals.
- Carry out scaling, damping and square root extraction.

(6)SC function block

- Converts the input signal value based on the segment table function.

(7)IT function block

- Integrates one or two input signals and outputs the result.

(8)IS function block

- Selects one of multiple input signals according to the specified selection method and outputs the signal.

(9)AR function block

- Performs ten types of calculations on a combination of two main input signals and three auxiliary input signals.

(10)PID function block

- Performs the PID control computation based on the deviation of the measured value from the setpoint.

3.3 Logical Structure of Each Block

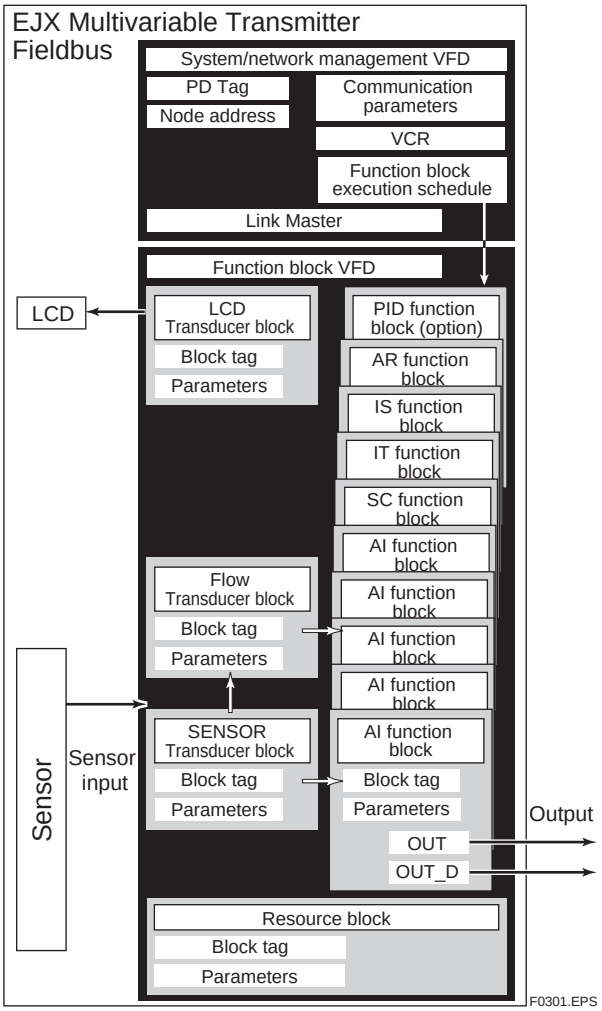


Figure 3.1 Logical Structure of Each Block

Setting of various parameters, node addresses, and PD Tags shown in Figure 3.1 is required before starting operation.

3.4 Wiring System Configuration

The number of devices that can be connected to a single bus and the cable length vary depending on system design. When constructing systems, both the basic and overall design must be carefully considered to achieve optimal performance.

4. GETTING STARTED

Fieldbus is fully dependent upon digital communication protocol and differs in operation from conventional 4 to 20 mA transmission and the HART communication protocol. It is recommended that novice users use field devices in accordance with the procedures described in this section. The procedures assume that field devices will be set up on a bench or in an instrument shop.

4.1 Connection of Devices

The following are required for use with Fieldbus devices:

- **Power supply:**
  Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.
- **Terminator:**
  Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.
- **Field devices:**
  Connect Fieldbus communication type EJX multivariable transmitter. Two or more EJX devices or other devices can be connected.
- **Host:**
  Used for accessing field devices. A dedicated host (such as DCS) is used for an instrumentation line while dedicated communication tools are used for experimental purposes. For operation of the host, refer to the instruction manual for each host. No other details on the host are given in this manual.
- **Cable:**
  Used for connecting devices. Refer to “Fieldbus Technical Information” (TI 38K03A01-01E) for details of instrumentation cabling. For laboratory or other experimental use, a twisted pair cable two to three meters in length with a cross section of 0.9 mm^2 or more and a cycle period of within 5 cm (2 inches) may be used. Termination processing depends on the type of device being deployed. For EJX multivariable transmitter, use an M4 screw terminal claw. Some hosts require a connector.

Refer to Yokogawa when making arrangements to purchase the recommended equipment.

Connect the devices as shown in Figure 4.1. Connect the terminators at both ends of the trunk, with a minimum length of the spur laid for connection.

The polarity of signal and power must be maintained.

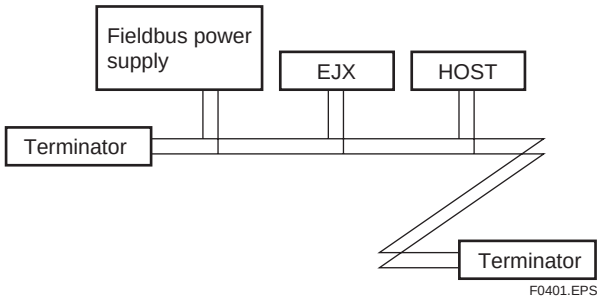


Figure 4.1 Cabling

NOTE

No CHECK terminal is used for Fieldbus EJX multivariable transmitter. Do not connect the field indicator and check meter.

Before using a Fieldbus configuration tool other than the existing host, confirm it does not affect the loop functionality in which all devices are already installed in operation. Disconnect the relevant control loop from the bus if necessary.

IMPORTANT

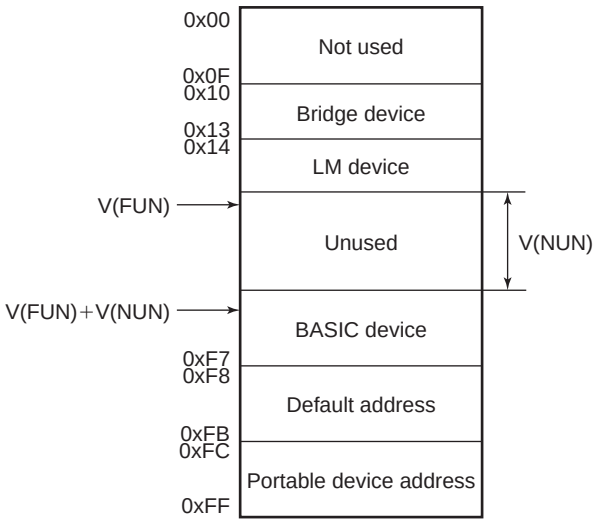
Connecting a Fieldbus configuration tool to a loop with its existing host may cause communication data scrambling resulting in a functional disorder or a system failure.

4.2 Host Setting

To activate Fieldbus, the following settings are required for the host. Set the available address range to cover the address set for EJX multivariable transmitter's.

IMPORTANT

Do not turn off the power immediately after setting. When the parameters are saved to the EEPROM, the redundant processing is executed for an improvement of reliability. If the power is turned off within 60 seconds after setting is made, the modified parameters are not saved and the settings may return to the original values.



Note 1: Bridge device: A linking device which brings data from one or more H1 networks.
Note 2: LM device: with bus control function (Link Master function)
Note 3: BASIC device: without bus control function

F0402.EPS

Figure 4.2 Available Address Range

Table 4.1 Operation Parameters

Symbol	Parameter	Description and Settings
V (ST)	Slot-Time	Indicates the time necessary for immediate reply of the device. Unit of time is in octets (256 μs). Set maximum specification for all devices. For EJX, set a value of 4 or greater.
V (MID)	Minimum-Inter-PDU-Delay	Minimum value of communication data intervals. Unit of time is in octets (256 μs). Set the maximum specification for all devices. For EJX, set a value of 4 or greater.
V (MRD)	Maximum-Reply-Delay	The worst case time elapsed until a reply is recorded. The unit is Slot-time; set the value so that V (MRD) ×V (ST) is the maximum value of the specification for all devices. For EJX, the setting must be a value of 12 or greater.
V (FUN)	First-Unpolled-Node	Indicate the address next to the address range used by the host. Set 0×15 or greater.
V (NUN)	Number-of-consecutive-Unpolled-Node	Unused address range.

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4.3 Bus Power ON

Turn on the power of the host and the bus. Where the EJX multivariable transmitter is equipped with an LCD indicator, first all segments are lit, then the display begins to operate. If the indicator is not lit, check the polarity of the power supply.

Using the host device display function, check that the EJX multivariable transmitter is in operation on the bus.

The device information, including PD tag, Node address, and Device ID, is described on the sheet attached to the device. The device information is given in duplicate on this sheet.

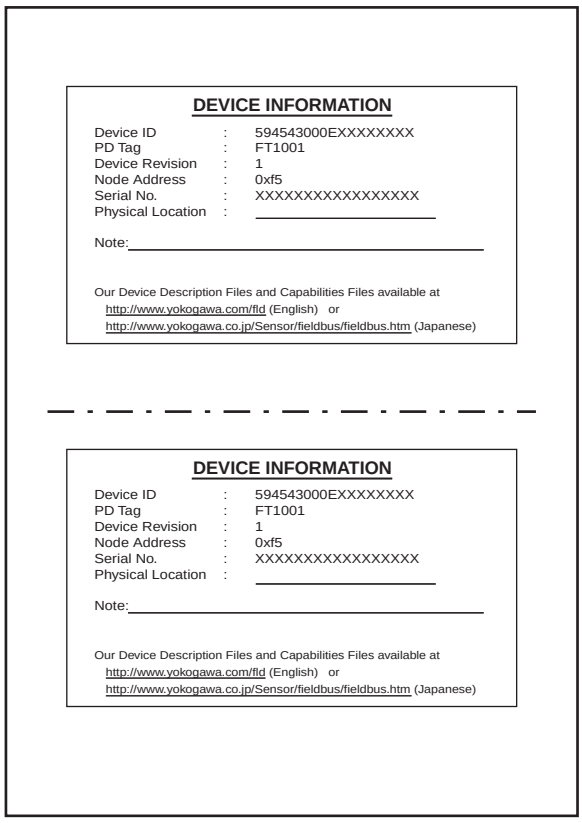

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Figure 4.3 Device Information Sheet Attached to EJX

If no EJX multivariable transmitter is detected, check the available address range and the polarity of the power supply. If the node address and PD tag are not specified when ordering, default value is factory set. If two or more devices are connected at a time with default value, only one device will be detected from the host as devices have the same initial address. Separately connect each device and set a different address for each.

4.4 Integration of DD

If the host supports DD (Device Description), the DD of the EJX multivariable transmitter needs to be installed. Check if host has the following directory under its default DD directory.

594543\000E
(594543 is the manufacturer number of Yokogawa Electric Corporation, and 000E is the EJX multivariable transmitter device number, respectively.)

If this directory is not found, the DD of the EJX910A has not been included. Create the above directory and copy the DD file (0m0n.ffo, 0m0n.sym) (m, n is a numeral) into the directory. '0m' in the file name shows the device revision, and '0n' shows the DD revision. If you do not have the DD or capabilities files, you can download them from our web site:

http://www.yokogawa.com/fld

Once the DD is installed in the directory, the name and attribute of all parameters of the EJX multivariable transmitter are displayed.

Off-line configuration is possible by using capabilities files.

EJX has two capabilities levels, "1" and "2".

Select "Capabilities level = 1" when the EJX don't have LC1(PID function) option.

Select "Capabilities level = 2" when the EJX has LC1(PID function) option.

The capabilities level defines the kind and the number of function blocks that can be used.
The table below shows the relation.

The relation between and function blocks that can be used

Capabilities Level	AI	SC	IT	IS	AR	PID
1	5	1	1	1	1	0
2	5	1	1	1	1	1

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4.5 Reading the Parameters

To read EJX multivariable transmitter parameters, select the AI1 block of the transmitter from the host screen and read the OUT parameter. The current selected signal is displayed. Check that MODE_BLOCK of the function block and resource block is set to AUTO, and change the signal input and read the parameter again. A new designated value should be displayed.

4.6 Continuous Record of Values

If the host has a function that continuously records the indications, use this function to list the indications (values). Depending on the host being used, it may be necessary to set the schedule of Publish (the function that transmits the indication on a periodic basis).

4.7 Generation of Alarm

Generation of an alarm can be attempted from EJX multivariable transmitter. Block alarm, Output limit alarm, and Update alarm are informed to the host. When generating alarm, a Link Object and a VCR Static Entry need to be set. For details of Link Object and VCR Static Entry, refer to section 5.6.1 Link object and section 5.5.1 VCR Setting.

5. CONFIGURATION

This chapter describes how to adapt the function and performance of the EJX multivariable transmitter to suit specific applications. Because multiple devices are connected to Fieldbus, it is important to carefully consider the device requirements and settings when configuring the system. The following steps must be taken.

(1)Network design
Determines the devices to be connected to Fieldbus and checks the capacity of the power supply.

(2)Network definition
Determines the tag and node addresses for all devices.

(3)Definition of combining function blocks
Determines how function blocks are combined.

(4)Setting tags and addresses
Sets the PD Tag and node addresses for each device.

(5)Communication setting
Sets the link between communication parameters and function blocks.

(6)Block setting
Sets the parameters for function blocks.

The following section describes in sequence each step of this procedure. The use of a dedicated configuration tool significantly simplifies this procedure. Refer to Appendix 6 when the EJX multivariable transmitter is used as Link Master.

5.1 Network Design

Select the devices to be connected to the Fieldbus network. The following are essential for the operation of Fieldbus.

- **Power supply**
  Fieldbus requires a dedicated power supply. It is recommended that current capacity be well over the total value of the maximum current consumed by all devices (including the host). Conventional DC current cannot be used as is.
- **Terminator**
  Fieldbus requires two terminators. Refer to the supplier for details of terminators that are attached to the host.
- **Field devices**
  Connect the field devices necessary for instrumentation. The EJX multivariable transmitter has passed the interoperability test conducted by The Fieldbus Foundation. In order to properly start Fieldbus, it is recommended that the devices used satisfy the requirements of the above test.
- **Host**
  Used for accessing field devices. A minimum of one device with the bus control function is needed.
- **Cable**
  Used for connecting devices. Refer to “Fieldbus Technical Information” for details of instrumentation cabling. Provide a cable sufficiently long to connect all devices. For field branch cabling, use terminal boards or a connection box as required.

First, check the capacity of the power supply. The power supply capacity must be greater than the sum of the maximum current consumed by all devices to be connected to Fieldbus. The maximum current consumed (power supply voltage 9 V to 32 V) for the EJX multivariable transmitter is 15 mA (24 mA in Software download operation). The cable used for the spur must be of the minimum possible length.

5.2 Network Definition

Before connection of devices with Fieldbus, define the Fieldbus network. Allocate PD Tag and node addresses to all devices (excluding such passive devices as terminators).

The PD Tag is the same as the conventional one used for the device. Up to 32 alphanumeric characters may be used for definition. Use a hyphen as a delimiter as required.

The node address is used to specify devices for communication purposes. Because this data is too long for a PD Tag, the host uses the node address in place of the PD Tag for communication. A range of 20 to 247 (or hexadecimal 14 to F7) can be set. The device

(LM device) with bus control function (Link Master function) is allocated from a smaller address number (20) side, and other devices (BASIC device) without bus control function allocated from a larger address number (247) side respectively. Place the EJX multivariable transmitter in the range of the BASIC device. When the EJX multivariable transmitter is used as Link Master, place it in the range of the LM device. Set the range of addresses to be used to the LM device. Set the following parameters.

Table 5.1 Parameters for Setting Address Range

Symbol	Parameters	Description
V (FUN)	First-Unpolled-Node	Indicates the address next to the address range used for the host or other LM device.
V (NUN)	Number-of-consecutive-Unpolled-Node	Unused address range

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The devices within the address range written as "Unused" in Figure 5.1 cannot be used on a Fieldbus. For other address ranges, the range is periodically checked to identify when a new device is mounted. Care must be taken to keep the unused device range as narrow as possible so as to lessen the load on the Fieldbus.

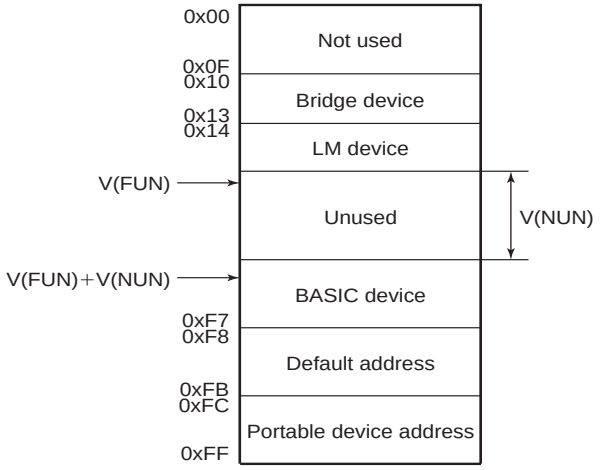

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Figure 5.1 Available Range of Node Addresses

To ensure stable operation of Fieldbus, determine the operation parameters and set them to the LM devices. While the parameters in Table 5.2 are to be set, the worst-case value of all the devices to be connected to the same Fieldbus must be used. Refer to the specification of each device for details. Table 5.2 lists EJX specification values.

Table 5.2 Operation Parameter Values of the EJX to be Set to LM Devices

Symbol	Parameters	Description and Settings
V (ST)	Slot-Time	Indicates the time necessary for immediate reply of the device. Unit of time is in octets (256 μs). Set maximum specification for all devices. For EJX, set a value of 5 or greater.
V (MID)	Minimum-Inter-PDU-Delay	Minimum value of communication data intervals. Unit of time is in octets (256 μs). Set the maximum specification for all devices. For EJX, set a value of 4 or greater.
V (MRD)	Maximum-Reply-Delay	The worst case time elapsed until a reply is recorded. The unit is Slot-time; set the value so that V (MRD) ×V (ST) is the maximum value of the specification for all devices. For EJX, the setting must be a value of 12 or greater.

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5.3 Definition of Combining Function Blocks

The input/output parameters for function blocks are combined. As required, they can be combined with the input of the control block. The setting is written to the EJX link object. See "Block setting" in Section 5.6 for the details. It is also possible to read values from the host at proper intervals instead of connecting the EJX block output to other blocks.

The combined blocks need to be executed synchronously with other blocks on the communications schedule. In this case, change the EJX schedule according to the following table. The values in the table are factory-settings.

Table 5.3 Execution Schedule of the EJX Function Blocks

Index	Parameters	Setting (Enclosed is factory-setting)
269 (SM)	MACROCYCLE_ DURATION	Cycle (MACROCYCLE) period of control or measurement. Unit is 1/32 ms. (16000 = 0.5 s)
276 (SM)	FB_START_ENTRY.1	AI1 block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32 ms. (0 = 0 s)
277 (SM)	FB_START_ENTRY.2	AI2 block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32ms.(8000=250ms)
278 (SM)	FB_START_ENTRY.3	AI3 block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32ms.(16000=500ms)
279 (SM)	FB_START_ENTRY.4	AI4 block startup time. Elapsed time from the start of MACROCYCLE specified in 1/32ms. (24000=750ms)
280 to 289 (SM)	FB_START_ENTRY.5 to FB_START_ENTRY.14	Not used.

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A maximum of 30 ms is taken for execution of AI block. For scheduling of communications for combination with the next function block, the execution is so arranged as to start after a lapse of longer than 30 ms. In no case should function blocks of the EJX be executed at the same time (execution time is overlapped).

Figure 5.3 shows an example of schedule based on the loop shown in Figure 5.2.

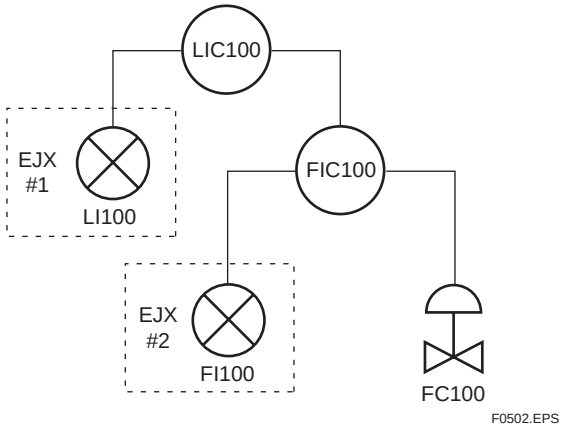

Figure 5.2 Example of Loop Connecting Function Block of Two EJX with Other Instruments

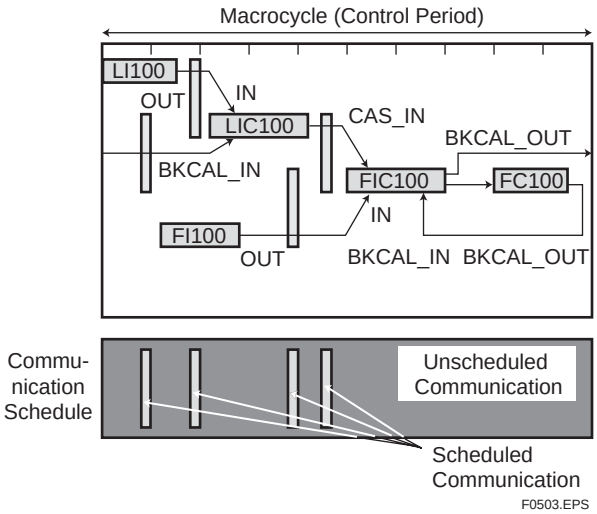

Figure 5.3 Function Block Schedule and Communication Schedule

When the control period (macrocycle) is set to more than 4 seconds, set the following intervals to be more than 1% of the control period.

- Interval between “end of block execution” and “start of sending CD from LAS”
- Interval between “end of block execution” and “start of the next block execution”

5.4 Setting of Tags and Addresses

This section describes the steps in the procedure to set PD Tags and node addresses in the EJX multivariable transmitter. There are three states of Fieldbus devices as shown in Figure 5.4, and if the state is other than the lowest SM_OPERATIONAL state, no function block is executed. EJX must be transferred to this state when an EJX tag or address is changed.

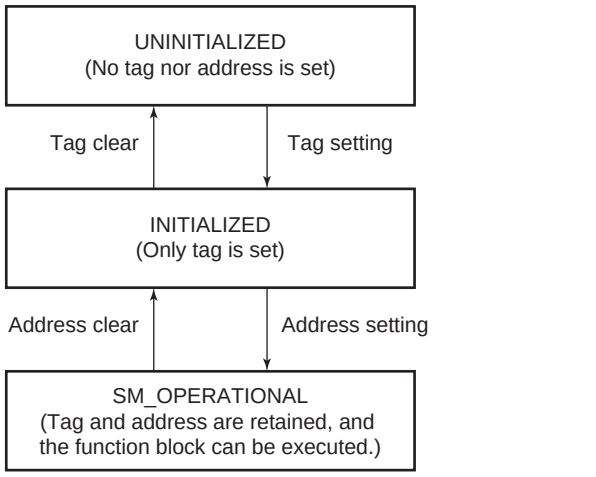

Figure 5.4 Status Transition by Setting PD Tag and Node Address

EJX multivariable transmitter has a PD Tag (FT2001) and node address (245, or hexadecimal F5) that are set upon shipment from the factory unless otherwise specified. To change only the node address, clear the address once and then set a new node address. To set the PD Tag, first clear the node address and clear the PD Tag, then set the PD Tag and node address again.

Devices whose node addresses have been cleared will have the default address (randomly chosen from a range of 248 to 251, or from hexadecimal F8 to FB). At the same time, it is necessary to specify the device ID in order to correctly specify the device. The device ID of the EJX multivariable transmitter is 594543000Exxxxxxxx. (The xxxxxxxx at the end of the above device ID is a total of 8 alphanumeric characters.)

5.5 Communication Setting

To set the communication function, it is necessary to change the database residing in SM-VFD.

5.5.1 VCR Setting

Set VCR (Virtual Communication Relationship), which specifies the called party for communication and resources. EJX multivariable transmitter has 33 VCRs whose application can be changed, except for the first VCR, which is used for management.

EJX multivariable transmitter has VCRs of four types:

Server(QUB) VCR
A Server responds to requests from a host. This communication needs data exchange. This type of communication is called QUB (Queued User-triggered Bidirectional) VCR.

Source (QUU) VCR
A Source multicasts alarms or trends to other devices. This type of communication is called QUU (Queued User-triggered Unidirectional) VCR.

Publisher (BNU) VCR
A Publisher multicasts block output to another function block(s). This type of communication is called BNU (Buffered Network-triggered Unidirectional) VCR.

Subscriber (BNU) VCR
A Subscriber receives output of another function block(s).

A Server VCR is capable to responding to requests from a Client (QUB) VCR after the Client successfully initiates connection to the Server. A Source VCR transmits data without established connection. A Sink (QUU) VCR on another device can receive it if the Sink is configured so. A Publisher VCR transmits data when LAS requests so. An explicit connection is established from Subscriber (BNU) VCR(s) so that a Subscriber knows the format of published data.

Each VCR has the parameters listed in Table 5.4. Parameters must be changed together for each VCR because modification of individual parameters may cause inconsistent operation.

Table 5.4 VCR Static Entry

Sub-index	Parameter	Description
1	FasArTypeAndRole	Indicates the type and role of communication (VCR). The following 4 types are used for EJX. 0x32: Server (Responds to requests from host.) 0x44: Source (Transmits alarm or trend.) 0x66: Publisher (Sends block output to other blocks.) 0x76: Subscriber (Receives output of other blocks.)
2	FasDllLocalAddr	Sets the local address to specify VCR in EJX. A range of 20 to F7 in hexadecimal.
3	FasDllConfigured RemoteAddr	Sets the node address of the called party for communication and the address (DLSAP or DLCEP) used to specify VCR in that address. For DLSAP or DLCEP, a range of 20 to F7 in hexadecimal is used. Addresses in Subindex 2 and 3 need to be set to the same contents of the VCR as the called party (local and remote are reversed).
4	FasDllSDAP	Specifies the quality of communication. Usually, one of the following types is set. 0x2B: Server 0x01: Source (Alert) 0x03: Source (Trend) 0x91: Publisher/Subscriber
5	FasDllMaxConfirm DelayOnConnect	To establish connection for communication, a maximum wait time for the called party's response is set in ms. Typical value is 60 secounds (60000).
6	FasDllMaxConfirm DelayOnData	For request of data, a maximum wait time for the called party's response is set in ms. Typical value is 60 secounds (60000).
7	FasDllMaxDlsduSize	Specifies maximum DL Service Data unit Size (DLSDU). Set 256 for Server and Trend VCR, and 64 for other VCRs.
8	FasDllResidual ActivitySupported	Specifies whether connection is monitored. Set TRUE (0xff) for Server. This parameter is not used for other communication.
9	FasDllTimelinessClass	Not used for EJX.
10	FasDllPublisherTime WindowSize	Not used for EJX.
11	FasDllPublisher SynchronizaingDlcep	Not used for EJX.

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Sub-index	Parameter	Description
12	FasDllSubsriberTime WindowSize	Not used for EJX.
13	FasDllSubscriber SynchronizationDlcep	Not used for EJX.
14	FmsVfdId	Sets VFD for EJX to be used. (0x1: System/network management VFD 0x1234: Function block VFD)
15	FmsMaxOutstanding ServiceCalling	Set 0 to Server. It is not used for other applications.
16	FmsMaxOutstanding ServiceCalled	Set 1 to Server. It is not used for other applications.
17	FmsFeatures Supported	Indicates the type of services in the application layer. In the EJX, it is automatically set according to specific applications.

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33 VCRs are factory-set as shown in the table below.

Table 5.5 VCR List

Index (SM)	VCR Number	Factory Setting
293	1	For system management (Fixed)
294	2	Server (LocalAddr = 0xF3)
295	3	Server (LocalAddr = 0xF4)
296	4	Server (LocalAddr = 0xF7)
297	5	Trend Source (LocalAddr = 0x07, Remote Address=0x111)
298	6	Publisher for AI1 (LocalAddr = 0x20)
299	7	Alert Source (LocalAddr = 0x07, Remote Address=0x110)
300	8	Server (LocalAddr = 0xF9)
301	9	Publisher for AI2 (LocalAddr = 0x21)
302 to 315	10 to 33	Not used.

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5.5.2 Function Block Execution Control

According to the instructions given in Section 5.3, set the execution cycle of the function blocks and schedule of execution.

5.6 Block Setting

Set the parameter for function block VFD.

5.6.1 Link Object

A link object combines the data voluntarily sent by the function block with the VCR. The EJX multivariable transmitter has 40 link objects. A single link object specifies one combination. Each link object has the parameters listed in Table 5.6. Parameters must be changed together for each VCR because the modifications made to each parameter may cause inconsistent operation.

Table 5.6 Link Object Parameters

Sub-index	Parameters	Description
1	LocalIndex	Sets the index of function block parameters to be combined; set “0” for Trend and Alert.
2	VcrNumber	Sets the index of VCR to be combined. If set to “0”, this link object is not used.
3	RemoteIndex	Not used in EJX. Set to “0”.
4	ServiceOperation	Set one of the following. Set only one each for link object for Alert or Trend. 0: Undefined 2: Publisher 3: Subscriber 6: Alert 7: Trend
5	StaleCountLimit	Set the maximum number of consecutive stale input values which may be received before the input status is set to BAD. To avoid the unnecessary mode transition caused when the data is not correctly received by subscriber, set this parameter to “2” or more.

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Set link objects as shown in Table 5.7.

Table 5.7 Factory-Settings of Link Objects (example)

Index	Link Object #	Factory Settings
30000	1	AI1.OUT → VCR#6
30001	2	Trend → VCR#5
30002	3	Alert → VCR#7
30003	4	AI2.OUT → VCR#9
30004 to 30039	5 to 40	Not used

T0507.EPS

5.6.2 Trend Object

It is possible to set the parameter so that the function block automatically transmits Trend. EJX multivariable transmitter has seven Trend objects, six of which are used for Trend in analog mode parameters and one is used for Trend in discrete mode parameter. A single Trend object specifies the trend of one parameter.

Each Trend object has the parameters listed in Table 5.8. The first four parameters are the items to be set. Before writing to a Trend object, it is necessary to release the WRITE_LOCK parameter.

Table 5.8 Parameters for Trend Objects

Sub-index	Parameters	Description
1	Block Index	Sets the leading index of the function block that takes a trend.
2	Parameter Relative Index	Sets the index of parameters taking a trend by a value relative to the beginning of the function block. In the EJX AI block, the following three types of trends are possible. 7: PV 8: OUT 19: FIELD_VAL
3	Sample Type	Specifies how trends are taken. Choose one of the following 2 types: 1: Sampled upon execution of a function block. 2: The average value is sampled.
4	Sample Interval	Specifies sampling intervals in units of 1/32 ms. Set the integer multiple of the function block execution cycle.
5	Last Update	The last sampling time.
6 to 21	List of Status	Status part of a sampled parameter.
21 to 37	List of Samples	Data part of a sampled parameter.

T0508.EPS

Seven trend objects are factory-set as shown Table 5.9.

Table 5.9 Trend Object are Factory-Set

Index	Parameters	Factory Settings
32000 to 32005	TREND_FLT.1 to TREND_FLT.5	Not used.
32006	TREND_DIS.1	Not used.

T0509.EPS

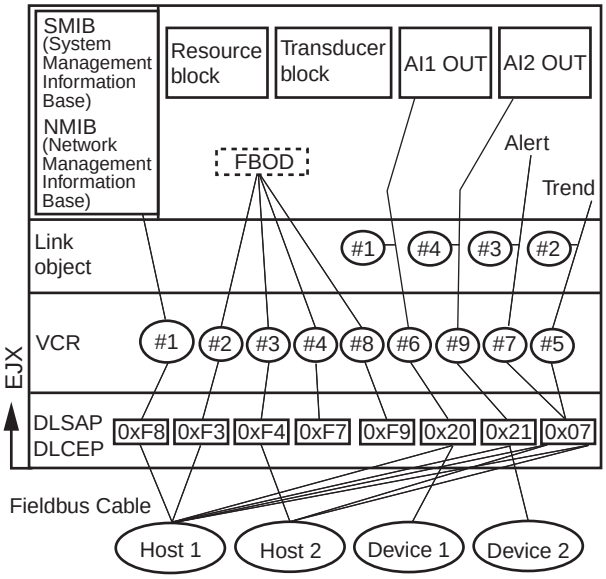

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Figure 5.5 Example of Default Configuration

5.6.3 View Object

This object forms a group of parameters in a block. One advantage brought by forming groups of parameters is the reduction of load for data transactions. View Object has the parameters listed in Table 5.11 to 5.15. Purpose of View Objects is shown in Table 5.10.

Table 5.10 Purpose of Each View Object

	Description
VIEW_1	Set of dynamic parameters required by operator for plant operation. (PV, SV, OUT, Mode etc.)
VIEW_2	Set of static parameters which need to be shown to plant operator at once. (Range etc.)
VIEW_3	Set of all the dynamic parameters.
VIEW_4	Set of static parameters for configuration or maintenance.

T0510.EPS

Table 5.11 View Object for Resource Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	RS_STATE	1		1	
8	TEST_RW				
9	DD_RESOURCE				
10	MANUFAC_ID				4
11	DEV_TYPE				2
12	DEV_REV				1
13	DD_REV				1
14	GRANT_DENY		2		
15	HARD_TYPES				2
16	RESTART				
17	FEATURES				2
18	FEATURE_SEL		2		
19	CYCLE_TYPE				2
20	CYCLE_SEL		2		
21	MIN_CYCLE_T				4
22	MEMORY_SIZE				2
23	NV_CYCLE_T		4		
24	FREE_SPACE		4		
25	FREE_TIME	4		4	
26	SHED_RCAS		4		
27	SHED_ROUT		4		
28	FAULT_STATE	1		1	
29	SET_FSTATE				
30	CLR_FSTATE				
31	MAX_NOTIFY				1
32	LIM_NOTIFY		1		
33	CONFIRM_TIME		4		
34	WRITE_LOCK		1		
35	UPDATE_EVT				
36	BLOCK_ALM				
37	ALARM_SUM	8		8	
38	ACK_OPTION				2
39	WRITE_PRI				1
40	WRITE_ALM				
41	ITK_VER				2
42	SOFT_REV				
43	SOFT_DESC				
44	SIM_ENABLE_MSG				
45	DEVICE_STATUS_1			4	
46	DEVICE_STATUS_2			4	
47	DEVICE_STATUS_3			4	
48	DEVICE_STATUS_4			4	
49	DEVICE_STATUS_5			4	
50	DEVICE_STATUS_6			4	
51	DEVICE_STATUS_7			4	
52	DEVICE_STATUS_8			4	
53	SOFTDWN_PROTECT				1
54	SOFTDWN_FORMAT				1
55	SOFTDWN_COUNT				2
56	SOFTDWN_ACT_AREA			1	
57	SOFTDWN_MOD_REV			16	
58	SOFTDWN_ERROR			2	
	Totals (# bytes)	22	30	73	35

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T0511-2.EPS

Table 5.12 View Object for SENSOR Transducer Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3_1	VIEW 3_2	VIEW 3_3	VIEW 3_4	VIEW 4_1	VIEW 4_2	VIEW 4_3	VIEW 4_4	VIEW 4_5
1	ST_REV	2	2	2	2	2	2	2	2	2	2	2
2	TAG_DESC											
3	STRATEGY							2				
4	ALERT_KEY							1				
5	MODE_BLK	4		4								
6	BLOCK_ERR	2		2								
7	UPDATE_EVT											
8	BLOCK_ALM											
9	TRANSDUCER_DIRECTORY											
10	TRANSDUCER_TYPE	2	2	2				2				
11	XD_ERROR	1		1								
12	COLLECTION_DIRECTORY											
13	PRIMARY_VALUE_TYPE		2									
14	PRIMARY_VALUE	5		5								
15	PRIMARY_VALUE_RANGE							11				
16	CAL_POINT_HI		4									
17	CAL_POINT_LO		4									
18	CAL_MIN_SPAN							4				
19	CAL_UNIT							2				
20	SENSOR_TYPE							2				
21	SENSOR_RANGE							11				
22	SENSOR_SN								32			
23	SENSOR_CAL_METHOD								1			
24	SENSOR_CAL_LOC								32			
25	SENSOR_CAL_DATE								7			
26	SENSOR_CAL_WHO								32			
27	SENSOR_ISOLATOR_MTL							2				
28	SENSOR_FILL_FLUID							2				
29	SECONDARY_VALUE	5		5								
30	SECONDARY_VALUE_UNIT		2									
31	CAL_DEVIATION_HI		4									
32	CAL_DEVIATION_LO		4									
33	EXTERNAL_ZERO_TRIM							1				
34	PRIMARY_VALUE_FTIME		4									
35	TERTIARY_VALUE	5		5								
36	SP_VALUE_TYPE		2									
37	SP_VALUE_RANGE							11				
38	CAL_SP_POINT_HI		4									
39	CAL_SP_POINT_LO		4									
40	CAL_SP_MIN_SPAN							4				
41	CAL_SP_UNIT							2				
42	CAL_SP_DEVIATION_HI		4									
43	CAL_SP_DEVIATION_LO		4									
44	SP_VALUE_FTIME		4									
45	ATM_PRESS		4									
46	CURRENT_ATM_PRESS_ENABLE		1									
47	EXT_TEMP_VAL	5		5								
48	EXT_TEMP_RANGE							11				
49	CAL_EXT_TEMP_POINT_HI		4									
50	CAL_EXT_TEMP_POINT_LO		4									
51	CAL_EXT_TEMP_MIN_SPAN							4				
52	CAL_EXT_TEMP_UNIT							2				
53	CAL_EXT_TEMP_DEVIATION_HI		4									
54	CAL_EXT_TEMP_DEVIATION_LO		4									
55	EXT_TEMP_VALUE_FTIME		4									
56	EXT_TEMP_OPTS		2									
57	FIXED_EXT_TEMP_VALUE		4									
58	SIMULATE_MODE		1									

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Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3_1	VIEW 3_2	VIEW 3_3	VIEW 3_4	VIEW 4_1	VIEW 4_2	VIEW 4_3	VIEW 4_4	VIEW 4_5
59	SIMULATE_DPRESS				5							
60	SIMULATE_SPRESS				5							
61	SIMULATE_ETEMP				5							
62	EXT_TEMP_SENSOR_SN											
63	CLEAR_CAL											
64	CAP_TEMP_VAL	5		5								
65	CAP_TEMP_RANGE							11				
66	AMP_TEMP_VAL	5		5								
67	AMP_TEMP_RANGE							11				
68	MODEL									16		
69	SPECIAL_ORDER_ID									32		
70	MANUFAC_DATE									7		
71	CAP_GASKET_MTL									1		
72	FLANGE_MTL									1		
73	D_VENT_PLUG									1		
74	FLANGE_TYPE									1		
75	REM_SEAL_ISOL_MTL									1		
76	FLANGE_SIZE									1		
77	REM_SEAL_NUM									1		
78	REM_SEAL_FILL_FLUID									1		
79	REM_SEAL_TYPE									1		
80	ALARM_SUM	8		8								
81	AUTO_RECOVERY							1				
82	MS_CODE											
83	DIAG_MODE										1	
84	DIAG_PERIOD										2	
85	DIAG_PRI										1	
86	DIAG_ERR					2						
87	DIAG_H_ALM					13						
88	DIAG_L_ALM					13						
89	DIAG_OPTION										2	
90	REF_LIM_ FDPMIN										4	
91	REF_LIM_ FSPMIN										4	
92	REF_LIM_ BLKFMAX										4	
93	COMP_FLAG										1	
94	DIAG_LIM										40	
95	DIAG_COUNT										1	
96	REFERENCE_TIME										8	
97	REFERENCE_FDP										5	
98	REFERENCE_FSPL										5	
99	REFERENCE_FSPH										5	
100	REFERENCE_BLKF										5	
101	REFERENCE_DPAVG										5	
102	VALUE_TIME					8						
103	VALUE_ FDP					5						
104	VALUE_ FSPL					5						
105	VALUE_ FSPH					5						
106	VALUE_ BLKF					5						
107	VALUE_DPAVG					5						
108	RATIO_FDP					5						
109	RATIO_FSPL					5						
110	RATIO_FSPH					5						
111	CRATIO_FDP					5						
112	NRATIO_FDP					5						
113	DIAG_APPLICABLE					2						

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Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3_1	VIEW 3_2	VIEW 3_3	VIEW 3_4	VIEW 4_1	VIEW 4_2	VIEW 4_3	VIEW 4_4	VIEW 4_5
114	FLG_TEMP_VAL					5						
115	FLG_TEMP_RANGE											11
116	FLG_TEMP_COEF											4
117	FLG_TEMP_PRI											1
118	FLG_TEMP_H_LIM											4
119	FLG_TEMP_L_LIM											4
120	FLG_TEMP_ALM					13						
121	TEST_KEY1			4								
122	TEST_KEY2			16								
123	TEST_KEY3			32								
124	TEST1											
125	TEST2											
126	TEST3											
127	TEST4											
128	TEST5											
129	TEST6									2		
130	TEST7									2		
131	TEST8									1		
132	TEST9									1		
133	TEST10									1		
134	TEST11									2		
135	TEST12									2		
136	TEST13				15							
137	TEST14						38					
138	TEST15						30					
139	TEST16						33					
	Totals (# bytes)	49	82	101	32	108	103	99	106	77	95	26

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Table 5.13 View Object for LCD Transducer Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3_1	VIEW 4_1	VIEW 4_2	VIEW 4_3	VIEW 4_4
1	ST_REV	2	2	2	2	2	2	2
2	TAG_DESC							
3	STRATEGY				2			
4	ALERT_KEY				1			
5	MODE_BLK	4		4				
6	BLOCK_ERR	2		2				
7	UPDATE_EVT							
8	BLOCK_ALM							
9	TRANSDUCER_ DIRECTORY							
10	TRANSDUCER_TYPE	2	2	2	2			
11	XD_ERROR	1		1				
12	COLLECTION_ DIRECTORY							
13	DISPLAY_SEL		2					
14	INFO_SEL		1					
15	BLOCK_TAG1		32					
16	PARAMETER_SEL1		2					
17	DISPLAY_TAG1		8					
18	UNIT_SEL1		1					
19	DISPLAY_UNIT1		8					
20	EXP_MODE1		1					
21	BLOCK_TAG2		32					
22	PARAMETER_SEL2		2					
23	DISPLAY_TAG2		8					
24	UNIT_SEL2		1					
25	DISPLAY_UNIT2		8					
26	EXP_MODE2		1					
27	BLOCK_TAG3				32			
28	PARAMETER_SEL3				2			
29	DISPLAY_TAG3				8			
30	UNIT_SEL3				1			
31	DISPLAY_UNIT3				8			
32	EXP_MODE3				1			
33	BLOCK_TAG4				32			
34	PARAMETER_SEL4				2			
35	DISPLAY_TAG4				8			
36	UNIT_SEL4				1			
37	DISPLAY_UNIT4				8			
38	EXP_MODE4				1			
39	BAR_GRAPH_SELECT							
40	DISPLAY_CYCLE				1			
41	TEST40				1			
42	BLOCK_TAG5					32		
43	PARAMETER_SEL5					2		
44	DISPLAY_TAG5					8		
45	UNIT_SEL5					1		
46	DISPLAY_UNIT5					8		
47	EXP_MODE5					1		
48	BLOCK_TAG6					32		
49	PARAMETER_SEL6					2		
50	DISPLAY_TAG6					8		
51	UNIT_SEL6					1		
52	DISPLAY_UNIT6					8		
53	EXP_MODE6					1		
54	BLOCK_TAG7						32	
55	PARAMETER_SEL7						2	
56	DISPLAY_TAG7						8	
57	UNIT_SEL7						1	
58	DISPLAY_UNIT7						8	
59	EXP_MODE7						1	
60	BLOCK_TAG8						32	
61	PARAMETER_SEL8						2	
62	DISPLAY_TAG8						8	
63	UNIT_SEL8						1	
64	DISPLAY_UNIT8						8	
65	EXP_MODE8						1	
66	BLOCK_TAG9							32
67	PARAMETER_SEL9							2
68	DISPLAY_TAG9							8
69	UNIT_SEL9							1
70	DISPLAY_UNIT9							8
71	EXP_MODE9							1
72	BLOCK_TAG10							32
73	PARAMETER_SEL10							2
74	DISPLAY_TAG10							8
75	UNIT_SEL10							1
76	DISPLAY_UNIT10							8
77	EXP_MODE10							1
	Totals (# bytes)	11	112	11	113	106	106	106

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Table 5.14 View Object for Flow Transducer Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4_1	VIEW 4_2
1	ST_REV	2	2	2	2	2
2	TAG_DESC					
3	STRATEGY				2	
4	ALERT_KEY				1	
5	MODE_BLK	4		4		
6	BLOCK_ERR	2		2		
7	UPDATE_EVT					
8	BLOCK_ALM					
9	TRANSDUCER_DIRECTORY					
10	TRANSDUCER_TYPE	2	2	2	2	
11	XD_ERROR	1		1		
13	FLOW_VALUE_TYPE		1			
14	FLOW_VALUE	5		5		
15	FLOW_VALUE_UNIT				2	
16	FLOW_VALUE_DECIMAL				1	
17	FLOW_VALUE_FTIME		4			
18	DIFF_PRESSURE	5		5		
19	DIFF_PRESSURE_UNIT		2			
20	STATIC_PRESSURE	5		5		
21	STATIC_PRESSURE_UNIT		2			
22	EXT_TEMPERATURE	5		5		
23	EXT_TEMPERAURE_UNIT		2			
24	FLOW_CALCULATION_MODE		1			
25	FIXED_FLOW_VALUE				4	
26	REF_STATIC_PRESSURE				4	
27	REF_EXT_TEMPERATURE				4	
28	TEMP_K1_FOR_LIQUID				4	
29	FLUID_TYPE_CODE		1			
30	ALARM_SUM	8		8		
31	DENSITY_UNIT_CODE		2			
32	LENGTH_UNIT_CODE		2			
33	PRIMARY_DEVICE_CODE		1			
34	PRIMARY_DEVICE_DIAMETER		4			
35	PRIMARY_DEVICE_ EXPANSION_COEF		4			
36	PRIMARY_DEVICE_ REF_TEMPERATURE		4			
37	PIPE_DIAMETER		4			
38	PIPE_EXPANSION_COEF		4			
39	PIPE_REF_TEMPERATURE		4			
40	BASE_DENSITY_FOR_ VOLUME_FLOW		4			
41	FLOW_CONFIG1		20			
42	FLOW_CONFIG2		12			
43	FLOW_CONFIG3					
44	FLOW_CONFIG4		16			
45	CORRECTION_VALUE			32		
46	CONFIG_SOFT_REV				16	
47	CONFIG_DATE				16	
48	CONFIG_WHO				32	
49	CONFIG_STATUS				2	
50	CONFIG_VSTRING32					32
51	CONFIG_VSTRING16					32
52	CONFIG_OSTRING32					32
53	CONFIG_OSTRING2					2
	Totals (# bytes)	39	98	71	92	100

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Table 5.15 View Object for AI Function Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	OUT	5		5	
9	SIMULATE				
10	XD_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	IO_OPTS				2
14	STATUS_OPTS				2
15	CHANNEL				2
16	L_TYPE				1
17	LOW_CUT				4
18	PV_FTIME				4
19	FIELD_VAL	5		5	
20	UPDATE_EVT				
21	BLOCK_ALM				
22	ALARM_SUM	8		8	
23	ACK_OPTION				2
24	ALARM_HYS				4
25	HI_HI_PRI				1
26	HI_HI_LIM				4
27	HI_PRI				1
28	HI_LIM				4
29	LO_PRI				1
30	LO_LIM				4
31	LO_LO_PRI				1
32	LO_LO_LIM				4
33	HI_HI_ALM				
34	HI_ALM				
35	LO_ALM				
36	LO_LO_ALM				
37	OUT_D_SEL				2
38	OUT_D			2	
	Totals (# bytes)	31	26	33	48

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Table 5.16 Indexes of View for Each Block

	VIEW_1	VIEW_2	VIEW_3	VIEW_4
Resourse Block	40100	40101	40102	40103
SENSOR Transducer Block	40200	40201	40202 to 40203	40204 to 40206
FLOW Transducer block	40230	40231	40232	40233 to 40234
LCD Transducer Block	40250	40251	40252	40253
AI1 Function Block	40400	40401	40402	40403
AI2 Function Block	40410	40411	40412	40413
AI3 Function Block	40420	40421	40422	40423
AI4 Function block	40430	40431	40432	40433
AI5 Function block	40440	40441	40442	40443
PID Function Block	40800	40801	40802	40803
SC Function Block	41450	41451	41452	41453
IT Function Block	41600	41601	41602	41603
IS Function Block	41700	41701	41702	41703
AR Function Block	41750	41751	41752	41753

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5.6.4 Function Block Parameters

Function block parameters can be read from the host or can be set. For a list of the parameters of blocks held by the EJX multivariable transmitter, refer to “9. PARAMETERS LISTS”. For the function blocks other than AI block, LM function, software download function and advanced diagnostic, refer to Appendix 1 to 8.

6. EXPLANATION OF BASIC ITEMS

6.1 Outline

This chapter describes the SENSOR transducer block, the LCD transducer block, and the AI function block and explains basic parameter settings. Refer to Appendixes for other function blocks, LM function, and software download function.

6.2 Setting and Changing Parameters for the Whole Process

IMPORTANT

Do not turn off the power immediately after setting. When the parameters are saved to the EEPROM, the redundant processing is executed for an improvement of reliability. If the power is turned off within 60 seconds after setting is made, the modified parameters are not saved and the settings may return to the original values.

Block mode

Many parameters require a change of the block mode of the function block to O/S (Out of Service) when their data is changed. To change the block mode of the function block, its MODE_BLK needs to be changed. The MODE_BLK is comprised of the four sub-parameters below:

(1) Target (Target mode):
Sets the operating condition of the block.

(2) Actual (Actual mode):
Indicates the current operating condition.

(3) Permit (Permitted mode):
Indicates the operating condition that the block is allowed to take.

(4) Normal (Normal mode):
Indicates the operating condition that the block will usually take.

6.3 SENSOR Transducer Block

The SENSOR transducer block is in between the sensor and the AI function blocks. It calculates differential pressure, static pressure, external temperature, and capsule temperature from sensor signals. Then it performs damping and range checks for the measured values of these three variables and sends signals to the AI function block and Flow transducer block. Figure 6.1 presents the signal flow between blocks.

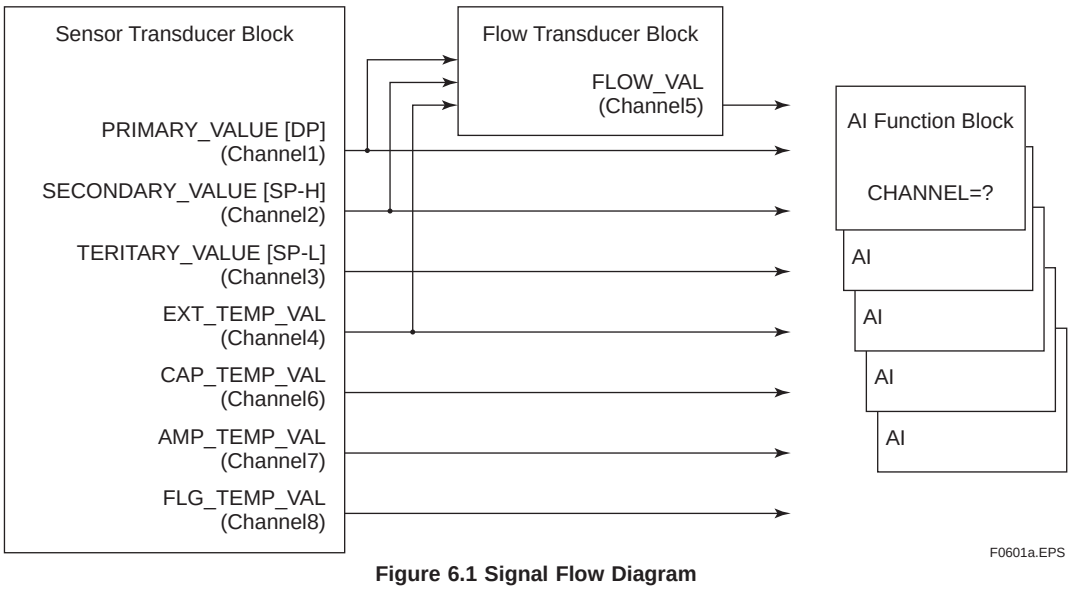

Figure 6.1 Signal Flow Diagram

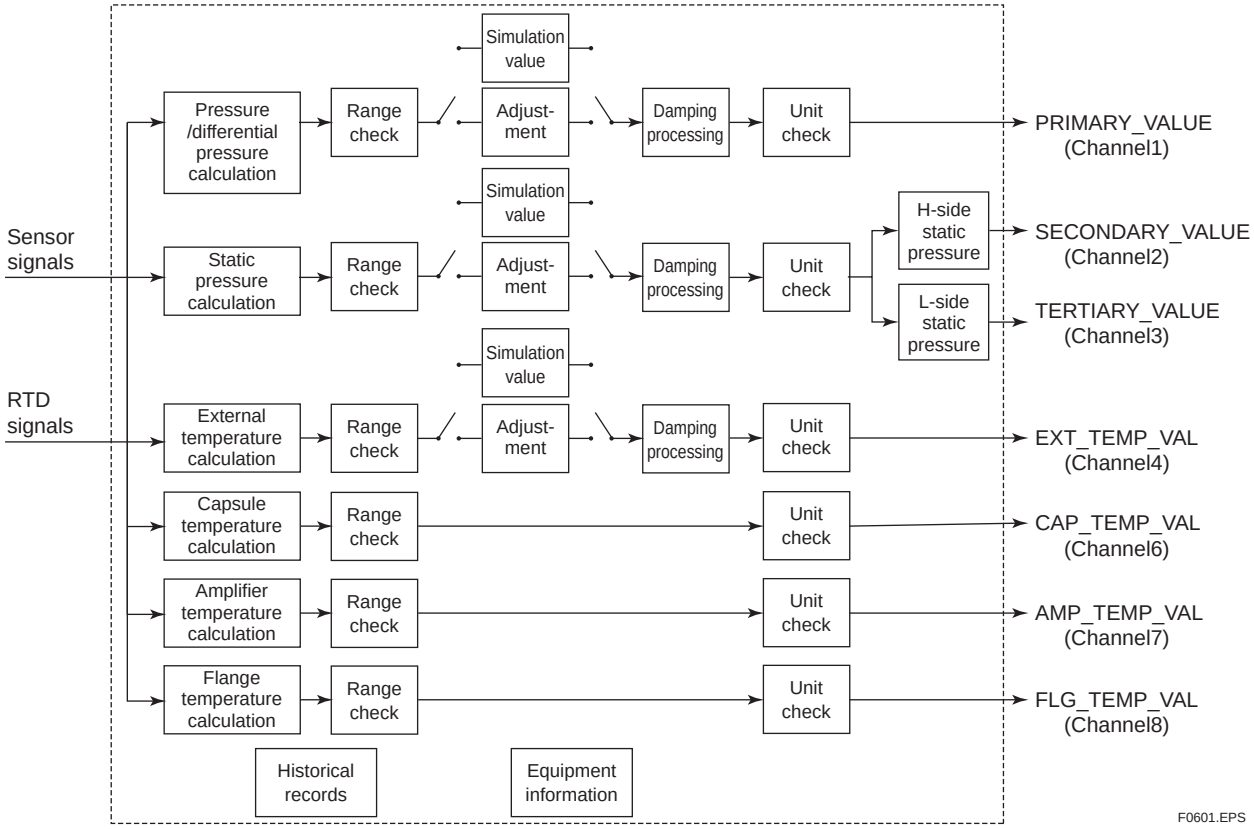

Figure 6.2 SENSOR Transducer Functional Block

6.3.1 Functional block

Figure 6.2 presents the functional block of the SENSOR transducer. The calculated values of differential pressure, H-side static pressure, L-side static pressure, external temperature, capsule temperature, amplifier temperature, and flange temperature (option code: /DG1) are assigned to PRIMARY_VALUE, SECONDARY_VALUE, TERTIARY_VALUE, EXT_TEMP_VAL, CAP_TEMP_VAL, AMP_TEMP_VAL, and FLG_TEMP_VAL (option code: /DG1) respectively. Measured values output to the AI function blocks are selected by the Channel parameter of those blocks.

6.3.2 Block Mode

The Block modes permitted for the SENSOR transducer block are Automatic (Auto) and Out of Service (O/S). The mode must be set to Auto under normal operating conditions, and to O/S when making changes to an important parameter. For parameters that can only be changed in the Auto and O/S modes, refer to the parameter list for the SENSOR Transducer block in Chapter 9.

6.3.3 Functions Relating to Differential Pressure

Reference to differential pressure value:
By accessing PRIMARY_VALUE, it is possible to refer to the differential pressure value and status. The update period of this value is 200 msec. The pressure unit is selected by XD_SCALE.unit of the AI block, in which PRIMARY_VALUE is selected. The status is normally Good-Non Specific. However, in the case of a sensor failure or out of measurement range, it turns to Bad or Uncertain. For details, refer to Table 8.9.

Setting of signal damping for differential pressure:
When the differential pressure signal fluctuates greatly, the fluctuation can be reduced by increasing the time constant for signal damping.
PRIMARY_VALUE_FTIME is the parameter for setting the signal damping for differential pressure. The unit of signal damping is second.

Determination of the range limit of differential pressure signal:
When the differential pressure signal deviates more than 10% from the capsule measurement range shown in PRIMARY_VALUE_RANGE, set the status of PRIMARY_VALUE to Uncertain-Sensor Conversion not Accurate.

Adjustment of pressure/differential pressure signal:
EJX multivariable transmitter have been accurately adjusted according to the specifications at factory setting. Minimal errors can occur due to the environment where the transmitter is installed and the mounting position. To fine-tune any errors, three zero/span adjustment functions can be used: automatic and manual zero/span adjustment by communication terminals, and zero-point adjustment by means of the external adjustment screw on the transmitter.

Automatic adjustment
The value of the pressure exerted on the point where the adjustment is to be made is assigned to parameters (CAL_POINT_LO, CAL_POINT_HI). After this assignment is set, the amount of adjustment is calculated by the transmitter and automatically updated.

Manual adjustment
From the exerted pressure and the output of the transmitter, calculate the amount of zero/span adjustment manually, and assign the calculated value to parameters (CAL_DEVIATION_LO, CAL_DEVIATION_HI).

Zero-point adjustment by the external screw.
With pressure being exerted on the point where the adjustment is to be made, zero adjustment needs to be performed. To do this, adjust the calculated value by turning the external Zero-point adjustment screw, so that it agrees with the actual input pressure (true value). The output value increases when the screw is rotated to the right. It decreases when the screw is rotated to the left. The adjustment width is small when the rotation speed is low and large when fast.

When performing zero-point adjustment by the external screw, EXTERNAL_ZERO_TRIM needs to be set to "Enable."

Procedure for automatic adjustment
The procedure for automatic adjustment is as follows:

(1) Change the Block mode
Set MODE_BLK to O/S.

(2) Enter zero% pressure
Apply the actual zero% pressure to EJX multivariable transmitter.

(3) Perform zero adjustment
When the value of the applied pressure is written to CAL_POINT_LO, EJX calculates the amount of adjustment for zero adjustment. The calculated amount of adjustment is incorporated into CAL_DEVIATION_LO.

(4) Input pressure for span adjustment
For span adjustment, apply the actual 100% pressure to EJX multivariable transmitter.

(5) Performance of span adjustment
When the value of the applied pressure is written to CAL_POINT_HI, EJX multivariable transmitter calculates the amount of adjustment for span adjustment. The calculated amount of adjustment is incorporated into CAL_DEVIATION_HI.

(6) Change the operation mode
Set MODE_BLK to AUTO for normal operation.

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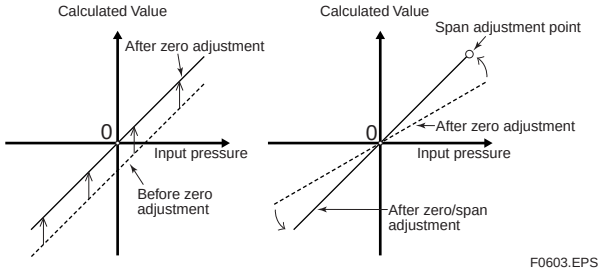

F0603.EPS

CAUTION

Span adjustment is a function for adjusting the gradient with respect to the point of zero adjustment. If that point is not zero, the gradient of input and output values cannot be accurately adjusted. Perform span adjustment after zero adjustment is completed.

Diagnosis of adjustment results:
When the amount of zero adjustment or span adjustment exceeds any of the following adjustment limits, "AL50: Adjustment range error for differential pressure" is displayed.

The conditions for zero/span adjustment are as follows:

<1> The point of zero adjustment is within ±10% of the capsule range.
<2> The amount of zero adjustment is within ±10% of the capsule range.
<3> The point of span adjustment is within the capsule range.
<4> The input and output gradients after span adjustment are within ±10% of the gradient at factory setting.

6.3.4 Functions Relating to Static Pressure

Reference to static pressure value:
In SECONDARY_VALUE and TERTIARY_VALUE, it is possible to refer to the H-side static pressure value and the L-side static pressure value, respectively. The update period of these values is 200 msec. The pressure unit is selected by XD_SCALE.unit in the AI block, in which SECONDARY_VALUE and TERTIARY_VALUE are selected. The status is normally Good-Non Specific. However, in the case of a sensor failure or out of measurement range, it turns to Bad or Uncertain. For specifics, refer to Table 8.9.

Setting of signal damping for static pressure:
SP_VALUE_FTIME is parameter that set signal damping for static pressure signals. The unit of the signal damping is second.

Determination of the range limit of static pressure signal:
When the static pressure signal exceeds the maximum working pressure (MWP) of the capsule, set the status of PRIMARY_VALUE to Uncertain-Subnormal. Also, set the status of SECONDARY_VALUE and TERTIARY_VALUE to Uncertain-Sensor Conversion not Accurate. The status under normal conditions is Good-Non Specific.

Adjustment of static pressure signal:
The zero/span adjustment function can be used for static signals, as in the case of differential pressure signals. However, the zero-point adjustment by the external screw function is not supported for static pressure signal.

Automatic adjustment
The value of the static pressure exerted on the point where adjustment is to be made is assigned to parameters (CAL_SP_POINT_LO, CAL_SP_POINT_HI). After this assignment is set, the amount of adjustment is calculated by the transmitter and automatically updated. The procedure for adjusting the static pressure signal is the same as that of differential pressure signal.

Manual adjustment
From the exerted pressure and the output of the transmitter, calculate the amount of zero/span adjustment manually and assign the calculated value to parameters (CAL_SP_DEVIATION_LO, CAL_SP_DEVIATION_HI).

Selection of static pressure signal type:
EJX910 multivariable transmitter measure the absolute static pressure. Based on the assumption that atmospheric pressure is constant, these transmitters can output signal equivalent to gauge pressure calculated by deducting the atmospheric pressure (fixed value) from the measured absolute pressure. The type of static pressure signal output to SECONDARY_VALUE and TERTIARY_VALUE is selected in SP_VALUE_TYPE. SP_VALUE_TYPE allows selection of gauge pressure or absolute pressure. When selecting gauge pressure, set the value of the atmospheric pressure (fixed value) to ATM_PRESS. The default value of ATM_PRESS is equal to the value of standard atmospheric pressure (101.325 kPa).

Atmospheric pressure automatic setting:
When "Set" is set to the CURRENT_ATM_PRESS_ENABLE parameter, the present L-side static pressure can be automatically assigned as the atmospheric pressure (ATM_PRESS). To make this assignment, the SENSOR transducer block must be set to the O/S mode. After the L-side static pressure has been assigned to ATM_PRESS, the value of CURRENT_ATM_PRESS_ENABLE automatically returns to "off".

6.3.5 Functions Relating to External Temperature

Reference to external temperature value:
The contact temperature and status of the RTD connected at EXT_TEMP_VAL can be referenced. The update period of this value is about 800 msec. The external temperature unit is the unit selected at XD_SCALE.Unit in the AI block where EXT_TEMP_VAL is selected. Usually, the status indicates Good-Non Specific; however, it changes to Bad or Uncertain during a sensor malfunction or when the measuring range is exceeded. For actual details, see Table 8.9 Parameter Operations at Error Occurrence.

Assignment of the damping time constant of the external temperature signal:
The EXT_TEMP_VALUE_FTIME parameter is for setting the damping parameter of the external temperature signal. The setting unit for this parameter is [seconds].

Judgment of range limit of the external temperature signal:
When the external temperature signal has deviated from the measuring range (-200 to 850°C) by 85°C or more, it is outside the external temperature specification range, and the status of the external temperature signal (EXT_TEM_VAL) is set to Uncertain-Sensor Conversion not Accurate.

Adjustment of external temperature signal:
A zero/span adjustment function is available for the external temperature signal just like for the pressure (differential pressure) signal.

Automatic adjustment
The temperature value is assigned to parameters (CAL_EXT_TEMP_LO and CAL_EXT_TEMP_HI) with the external temperature sensor immersed in the temperature to be adjusted. After this assignment is made, the adjustment amount is calculated internally by the transmitter and the adjustment amount is automatically updated. The procedure for adjusting the external temperature signal is the same as that of the differential pressure signal.

Manual adjustment
From the assigned temperature and the output of the transmitter, calculate the amount of zero/span adjustment manually and assign the calculated value to parameters (CAL_EXT_TEMP_DEVIATION_LO and CAL_EXT_TEMP_DEVIATION_HI).

Diagnosis of adjustment:
When the adjustment amount exceeds the following adjustment ranges, “AL52: Out of external temperature span adjustment amount range/AL52: Out of external temperature zero adjustment amount range” generate an alarm. The zero/span adjustment ranges are as follows:

(1) The ramp for the input/output of two adjustment points must be within 10% of the ramp set before shipment from the factory.
(2) The zero point adjustment amount must be within ±85°C of the temperature set before shipment from the factory.
(3) The zero point/span adjustment point must be in the range -210°C to 860°C.

Fixed external temperature mode:
The value obtained from the external temperature sensor or a user-specified fixed value can be selected for the external temperature signal. At the EXT_TEMP_OPTS parameter, select one of Selection 0 (No): External temperature sensor, 1 (Yes): External temperature fixed value mode, and 2 (Fall Back): Fixed mode at broken wire.

When the external temperature fixed mode or fixed mode at broken wire is selected, set the fixed value at FIXED_EXT_TEMP_VALUE.

6.3.6 Simulation Function

There are two simulation functions in EJX multivariable transmitter; one is the function commonly offered in FOUNDATION Fieldbus products to simulate input of each function block for loop check, and the other is the flow simulation function to simulate measured inputs for checking the result of flow calculation.

The simulation function described in this section is flow simulation function. For the other simulation function, see ‘7.3 Simulation Function.’

A preset fixed value can be output to the AI function block or FLOW transducer block instead of the differential pressure value, static pressure value and external temperature value calculated from the sensor signals.

Select the signal for enabling simulation in the SIMULATE_MODE parameter. Set the value and status to be used for simulation in the SIMULATE_DPRESS, SIMULATE_SPRESS, and SIMULATE_ETEMP parameters.

Parameter	Explanation
SIMULATE_ MODE	Select the signal for enabling simulation. 0= Simulation OFF 1= Differential pressure signal simulation ON 2= Static pressure signal simulation ON 3= Differential pressure signal + static pressure signal simulation ON 4= External temperature signal simulation ON 5= Differential pressure signal + external temperature signal simulation ON 6= Static pressure signal + external temperature signal simulation ON 7= Differential pressure signal + static pressure signal + external temperature signal simulation ON 15=Differential pressure signal + static pressure signal + external temperature signal (w/out damping processing) simulation ON
SIMULATE_ DPRESS	Set the differential pressure signal simulation value and status.
SIMULATE_ SPRESS	Set the static pressure signal simulation value and status.
SIMULATE_ ETEMP	Set the external temperature signal simulation value and status.

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The flow value becomes the simulation value which is calculated by using simulation value of DP, SP and ET. The LCD continuously displays the simulation value and alarm (AL.080 SNR.SIM) in alternating sequence.

Simulation continues for 10 minutes, then is released automaticaly.

If one of following alarm occurs, all the output data is hold to the value before alarm occurs.

AL.01 (CAP. ERR)
AL.02 (AMP. ERR)
AL.03 (ET. ERR)

The simulation mode will automatically be released after approximately ten minutes.

NOTE

If the DP or SP simulation value set by a user is out of the setting range of the product(capsule), the transmitter automatically use maximum or minimum settable value in place of actual setting value to perform simulation.
If the ET simulation value set by a user is out of the setting range, a configuration error occurs.

6.3.7 Functions Relating to Capsule and Amplifier Temperature

Reference to capsule and amplifier temperature value:
In CAP_TEMP_VAL and AMP_TEMP_VAL, it is possible to refer to the capsule and amplifier temperature value and status. The update period of this value is about 1 sec. The temperature unit is selected by XD_SCALE.unit of the AI block, in which CAP_TEMP_VAL is selected. The status is normally Good-Non Specific. However, in the case of sensor failure or out of measurement range, it turns to Bad or Uncertain. For specifics, refer to Table 8.9.

Determination of the range limit of capsule temperature:
The range of capsule temperature is from –40 to 120 °C. When the measured capsule temperature deviates from –50 to 130 °C range, set the status of CAP_TEMP_VAL to Uncertain-Sensor Conversion not Accurate. The status under normal conditions is Good-Non Specific. Also, set the status of PRIMARY_ VALUE, SECONDARY_VALUE and TERTIARY_ VALUE TO Uncertain-Subnormal.

Determination of the range limit of amplifier temperature:
The range of amplifier temperature is from –40 to 120°C. When the measured amplifier temperature deviates from –50 to 95°C range, set the status of AMP_TEMP_VAL to Uncertain-Sensor Conversion not Accurate. The status under normal conditions is Good-Non Specific.

6.3.8 Functions Relating to Flange Temperature (option code: /DG1)

Flange temperature value reference:
In FLG_TEMP_VAL, it is possible to refer to the flange temperature value and status. The update period of this value is about 1 sec. The temperature unit is selected by XD_SCALE.unit of the AI block, in which FLG_TEMP_VAL is selected. The status is normally Good-Non Specific. However, it turns to Bad or Uncertain when sensor failure happens. For specifics, refer to Table 8.9. For details of Flange Temperature, refer to APPENDIX 8.3.

6.3.9 BLOCK_ERR

BLOCK_ERR presents the cause of an error in the block. The SENSOR transducer block checks the following causes and sets the relevant bits.

BLOCK_ERR

Bit	Error	Cause
0	other	Differential pressure adjusted by zero/span adjustment out of measurement range, Static pressure adjusted by zero/span adjustment out of measurement range Pressure sensor failure, Capsule temperature sensor failure Electronic circuit failure
15	Out-of-Service	MODE_BLK.Target is O/S

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6.3.10 XD_ERROR

XD_ERROR is a parameter that contains codes for the most significant errors that can occur in the SENSOR transducer block. The errors of XD_ERROR supported by EJX multivariable transmitter and their causes are presented in the table below. When multiple errors occur and their error codes are different, the error with a larger code value is stored first.

XD_ERROR

Bit	Error	Cause
15	Out of Service	Sensor TB is in O/S mode.
18	Calibration error	An error occurred during calibration or a calibration error has been detected.
20	Electronics Failure	An electronic component has failed.
22	I/O Failure	An I/O failure has occurred.

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6.4 FLOW Transducer Block

6.4.1 Outline of the Functions

The differential pressure, static pressure and external temperature signal calculated in the SENSOR transducer block are input to this block, and the flow calculation is performed based on these signals. The result undergoes output processing (e.g. damping), and the flow signal is output to the AI function block.

6.4.2 Block Mode

The Block modes permitted for the FLOW transducer block are Automatic (Auto) and Out of Service (O/S). Note that the Automatic mode cannot be set when option code A (Multi Sensing) is selected in the measurement function.

For normal operation, select the Automatic mode. To change important parameters, the O/S mode must be selected. For details on how to identify parameters that can be changed in the Automatic mode and parameters that can be changed only in the O/S mode, see chapter 9. Parameter Lists.

6.4.3 Calculation of the Flow

The calculated flow value and status are stored to the FLOW_VALUE parameter. For details on the flow calculation, refer to EJX910A and EJX930A Multivariable Transmitters User's Manual (IM 01C25R01-01E). The update period of the flow calculation is 200 msec, and the flow calculation is not updated when the operation mode is O/S. Note that the Automatic mode cannot be set when option code A (Multi Sensing) is selected in the measurement function. There are two flow calculation modes: Auto Compensation mode and Basic mode. When flow calculation is performed in the Auto Compensation mode, the calculation coefficient must be calculated by the dedicated setup tool and downloaded to the transmitter. For details on this method, refer to the User's Manual (IM 01C25R51-01E) for the dedicated setup tool.

The procedure for setting the BASIC Mode is as follows. For details on how to calculate the Kfactor, refer to the EJX910A and EJX930A Multivariable Transmitters User's Manual (IM 01C25R01-01E).

BASIC Mode Setting Procedure

(1) Set the operation mode to O/S.
(2) Select easy flow calculation at FLOW_CALCULATION_MODE.
(3) Select the fluid code (liquid or gas) at FLUID_TYPE_CODE.
(4) Select the flow equation in the following table from the fluid type (liquid/gas) and flow unit category (mass flow/standard volume flow/volume flow).

Fluid type	Flow unit Category	Flow equation
Liquid	Mass Flow	Qm or Qv or Qv norm =Kfactor ×√(ΔP×(1+Temp K1×(T-Tb))) *1
	Normal-Standard Volume Flow	
	Volume Flow	
Gas	Mass Flow	Qm or Qv norm =Kfactor ×√(ΔP×Tb/T×SP/SPb) *1
	Normal-Standard Volume Flow	
	Volume Flow	Qv=Kfactor ×√(ΔP×T/Tb×SPb/SP) *1

*1 ═══ Custom setting Parameter

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(5) Set the required data (values marked by ==== in the above table) to the following parameters.
- Kfactor → FIXED_FLOW_VALUE
- Temp K1 → TEMP_K1_FOR_LIQUID
- Tb → REF_EXT_TEMP_TERATURE
- SPb → REF_STATIC_PRESSURE

(6) Set the operation mode to AUTO.

NOTE

To confirm the setting of flow calculation, use Simulation Function. See '6.3.6 Simulation Function.'

6.4.4 Flow Unit/Decimal Point Digit

The flow unit is indicated in the FLOW_VALUE_UNIT parameter and the number of digits past the flow decimal point is indicated in the FLOW_VALUE_DECIMAL parameter. As the content of these parameters is interlocked with sub parameters Unit and Decimal of XD_SCALE in the AI function block where the flow signal is selected, FLOW_VALUE_UNIT and FLOW_VALUE_DECIMAL also are automatically changed when XD_SCALE.Unit and XD_SCALE.Decimal are changed.

6.4.5 Flow Type Selection

Mass flow, volume flow and standard volume flow are automatically selected according to the flow unit. The currently selected flow type can be referenced at the FLOW_VALUE_TYPE parameter.

6.4.6 BLOCK_ERR

The BLOCK_ERR parameter indicates the cause of errors that occur in the block. On the FLOW transducer block, check the following error causes, and set the bit corresponding to the cause.

Bit	Name	Measurement function	
		Multi Sensing	Mass Flow Measurement
0	Other	Setting error*1	Compensation coefficient setting error*2 Precision flow setting checksum error*3
15	Out of Service	Not supported	O/S is set for ModeBLK.Target.

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*1: The mode other than O/S is set for ModeBLK.Target.
*2: The flow value is zero or less. This is supported only in the Auto Compensation mode.
*3: The sum value of the Auto Compensation flow setting does not agree with the value when it was written by the setup tool.

6.4.7 XD_ERROR

The XD_ERROR parameter indicates the most important error code among the errors that are currently occurring on the FLOW transducer block. The following table summarizes the content of supported XD_ERRORs and error codes.

When two or more error codes are being generated simultaneously, error codes are displayed with preference given to the largest error code.

Error Code	Error Name	Description	Support	
			Multi Setting	Mass Flow Measurement
15	Out of Service	FLOW TB is in the O/S mode.	–	◯
19	Configu-ration error	Other than O/S is set even though it is a Multi Sensing type.	◯	–
23	Data Integrity Error	The flow setting sum value does not agree with the value when it was written by the setup tool.	–	◯
15	Algo-rithm Error	The flow value is smaller than zero.	–	◯

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6.5 LCD Transducer Block

6.5.1 Outline of the Functions

The LCD transducer block controls alarms and measured values that are displayed on the integral indicator. It displays not only OUT signals from the AI blocks, but also I/O signals of the Installed blocks on the integral indicator.

6.5.2 Block Mode

The Block modes permitted for the LCD transducer block are Automatic (Auto) and Out of Service (O/S). Settings can be changed in the AUTO mode for this block, except the Block tag parameter.

6.5.3 Display Contents of the integral indicator

The components of the integral indicator are the bar graph, the title field, the center field for numerical values, the lower text field, and auxiliary characters. The contents and meanings of these components are as follows:

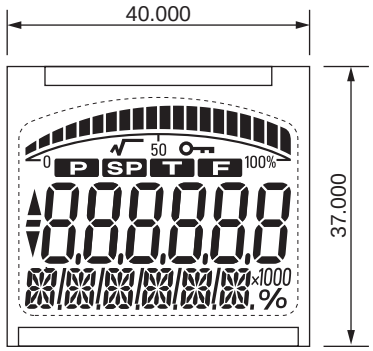

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Figure 6.3 Screen Display of the integral indicator

Component name	Contents	
Bar graph	Shows the value displayed in the center field for numerical values scaled in terms of percentage.	
Center field for numerical values	Presents values of inputs and outputs. While the alarm is on, the alarm number alternates with the displayed value here.	
Lower text field	Displays tag, parameter name, unit, and signal status. While the alarm is on, the alarm contents alternate.	
Title field	Depicts the type of the value displayed on the center field for numerical value.	
	P	Flashes when differential pressure is displayed.
	SP	Flashes when static pressure is displayed.
	T	Flashes when temperature is displayed.
	F	Flashes when flow rate is displayed.
Auxiliary characters	%	Flashes when the center field for numerical values displays a % value.
	√	Flashes when square root display is selected.
	Key mark	Flashes when Write Protect is selected.
	×10, ×100, ×1000	Used when the calculated value displayed in the center field for numerical values is rounded.

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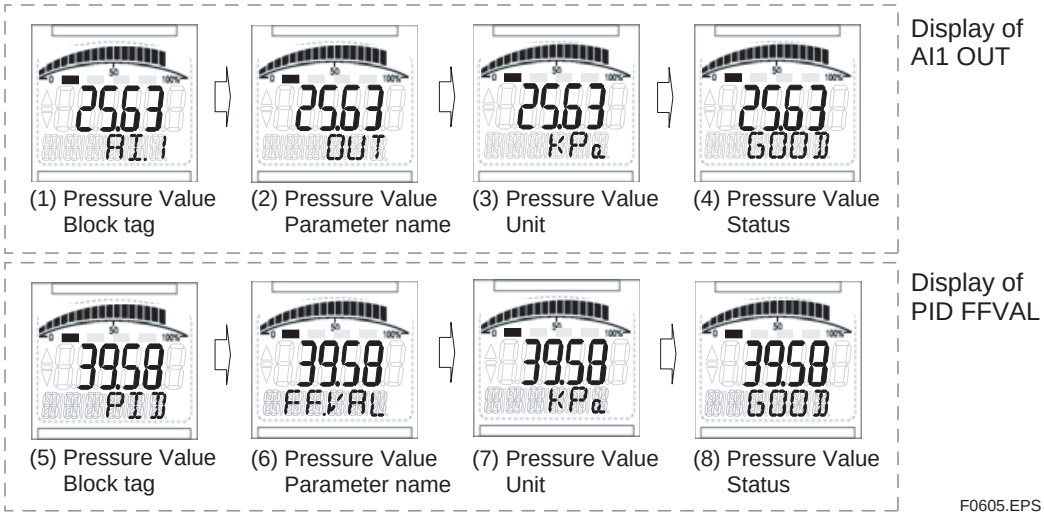
6.5.4 Example Displays of the integral indicator

Example display of AI1 OUT and PID FF_VAL, respectively



(1) Pressure Value Block tag
(2) Pressure Value Parameter name
(3) Pressure Value Unit
(4) Pressure Value Status

Display of AI1 OUT

(5) Pressure Value Block tag
(6) Pressure Value Parameter name
(7) Pressure Value Unit
(8) Pressure Value Status

Display of PID FFVAL

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Example display during mechanical failure alarm

F0606.EPS

Alarm number and
Error Massage (Capsule error)

6.5.5 Procedure to Set the Built-in Display

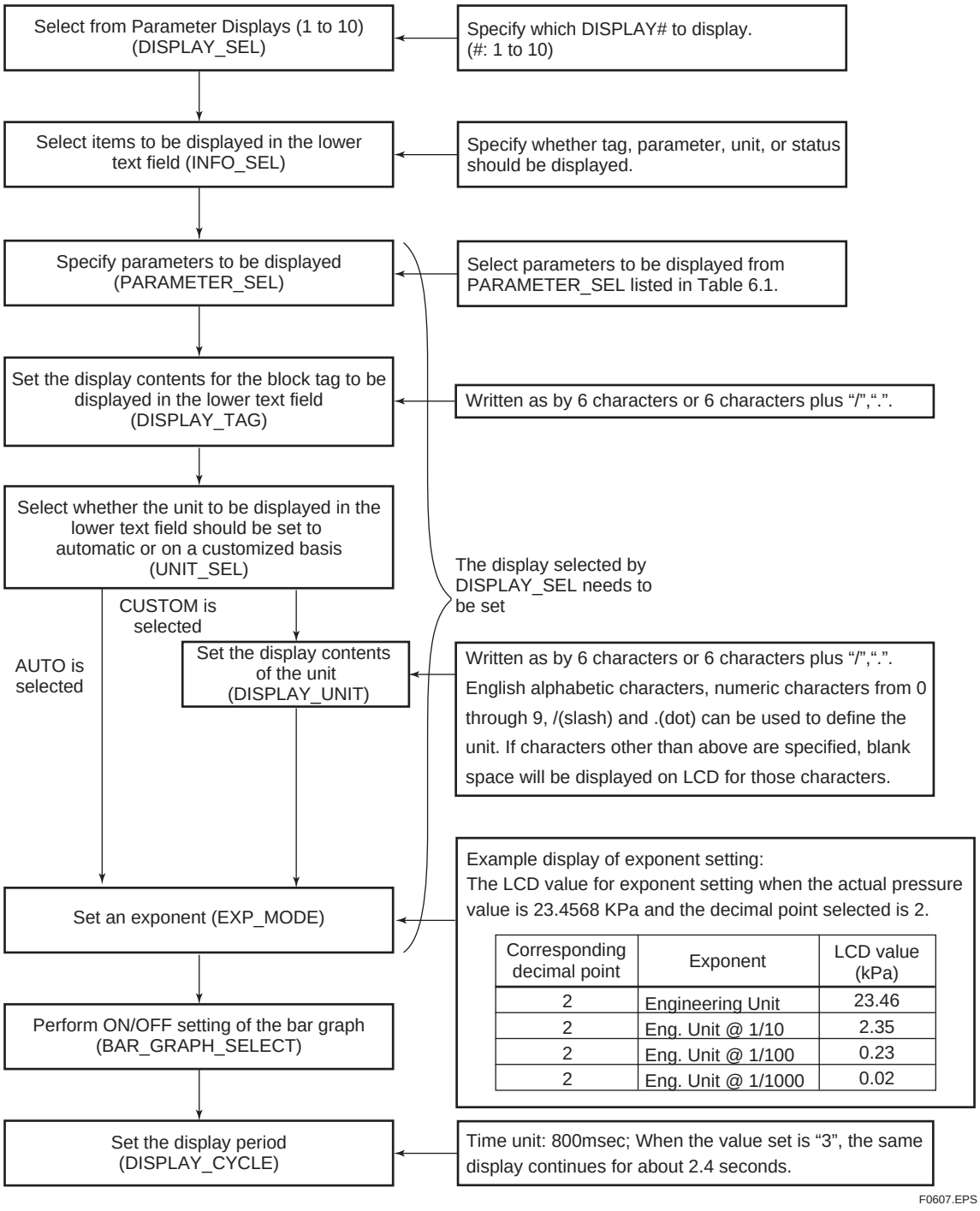
Select from Parameter Displays (1 to 10) (DISPLAY_SEL)
Specify which DISPLAY# to display. (#: 1 to 10)
Select items to be displayed in the lower text field (INFO_SEL)
Specify whether tag, parameter, unit, or status should be displayed.
Specify parameters to be displayed (PARAMETER_SEL)
Select parameters to be displayed from PARAMETER_SEL listed in Table 6.1.
Set the display contents for the block tag to be displayed in the lower text field (DISPLAY_TAG)
Written as by 6 characters or 6 characters plus "/",".".
Select whether the unit to be displayed in the lower text field should be set to automatic or on a customized basis (UNIT_SEL)
The display selected by DISPLAY_SEL needs to be set
CUSTOM is selected
AUTO is selected
Set the display contents of the unit (DISPLAY_UNIT)
Written as by 6 characters or 6 characters plus "/",".". English alphabetic characters, numeric characters from 0 through 9, /(slash) and .(dot) can be used to define the unit. If characters other than above are specified, blank space will be displayed on LCD for those characters.
Example display of exponent setting:
The LCD value for exponent setting when the actual pressure value is 23.4568 KPa and the decimal point selected is 2.
Corresponding decimal point
Exponent
LCD value (kPa)
2 Engineering Unit 23.46
2 Eng. Unit @ 1/10 2.35
2 Eng. Unit @ 1/100 0.23
2 Eng. Unit @ 1/1000 0.02
Set an exponent (EXP_MODE)
Perform ON/OFF setting of the bar graph (BAR_GRAPH_SELECT)
Set the display period (DISPLAY_CYCLE)
Time unit: 800msec; When the value set is "3", the same display continues for about 2.4 seconds.
F0607.EPS

Figure 6.4 Procedures to Set the Built-in Display

Table 6.1 Parameters to be displayed on LCD

Block Name	Parameter	PARAMETER_SEL	Display
SENSOR TRANSDUCER	PRIMARY_VALUE	PRIMARY VALUE	PV
	SECONDARY_VALUE	SECONDARY VALUE	SP.HI
	TERTIARY_VALUE	TERTIARY VALUE	SP.LO
	EXT_TEMP_VAL	EXT TMP VALUE	EXT.TMP
	CAP_TEMP_VAL	CAP TEMP VALUE	CAP.TMP
	APM_TEMP_VAL	APM TEMP VALUE	AMP.TMP
	FLG_TEMP_VAL*	FLG TEMP VALUE	FLG.TMP
FLOW TRANSDUCER	FLOW_VALUE	FLOW VALUE	FLOW
AI1	PV	AI1 PV	PV
	OUT	AI1 OUT	OUT
	FIELD_VAL	AI1 FIELD VAL	FLD.VAL
AI2	PV	AI2 PV	PV
	OUT	AI2 OUT	OUT
	FIELD_VAL	AI2 FIELD VAL	FLD.VAL
AI3	PV	AI3 PV	PV
	OUT	AI3 OUT	OUT
	FIELD_VAL	AI3 FIELD VAL	FLD.VAL
AI4	PV	AI4 PV	PV
	OUT	AI4 OUT	OUT
	FIELD_VAL	AI4 FIELD VAL	FED.VAL
AI5	PV	AI5 PV	PV
	OUT	AI5 OUT	OUT
	FIELD_VAL	AI5 FIELD VAL	FED.VAL
PID	SP	PID SP	SP
	PV	PID PV	PV
	OUT	PID OUT	OUT
	IN	PID IN	IN
	CAS.IN	PID CAS IN	CAS.IN
	BKCAL.IN	PID BKCAL IN	BKC.IN
	BKCAL.OUT	PID BKCAL OUT	BKC.OUT
	RCAS.IN	PID RCAS IN	RCAS.IN
	ROUT.IN	PID ROUT IN	ROUT.IN
	RCAS.OUT	PID RCAS OUT	RCA.OUT
	ROUT.OUT	PID ROUT OUT	ROU.OUT
	FF.VAL	PID FF VAL	FF.VAL
	TRK.VAL	PID TRK VAL	TRK.VAL
AR	OUT	AR OUT	OUT
	IN	AR IN	IN
	IN.LO	AR IN LO	IN.LO
	IN1	AR IN 1	IN1
	IN2	AR IN 2	IN2
	IN3	AR IN 3	IN3
IT	OUT	IT OUT	OUT
	IN1	IT IN 1	IN1
	IN2	IT IN 2	IN2
SC	OUT_1	SC OUT 1	OUT_1
	OUT_2	SC OUT 2	OUT_2
	IN_1	SC IN 1	IN1
	IN_2	SC IN 2	IN2
IS	OUT	IS OUT	OUT
	IN_1	IS IN 1	IN1
	IN_2	IS IN 2	IN2
	IN_3	IS IN 3	IN3
	IN_4	IS IN 4	IN4
	IN_5	IS IN 5	IN5
	IN_6	IS IN 6	IN6
	IN_7	IS IN 7	IN7
	IN_8	IS IN 8	IN8

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*: The flange temperature is not calculated without option code /DG1 so that 0 is displayed.

6.5.6 Units That Can Be Displayed on the LCD by the Automatic Link Function

Index	Unit	Display on the LCD
1000	K	K
1001	°C	deg C
1002	°F	deg F
1130	Pa	Pa
1131	GPa	GPa
1132	MPa	MPa
1133	kPa	kPa
1134	mPa	mPa
1135	μPa	uPa
1136	hPa	hPa
1137	bar	bar
1138	mbar	mbar
1139	torr	torr
1140	atm	atm
1141	psi	psi
1142	psia	psia
1143	psig	psig
1144	g/cm^2	g/cm2
1145	kg/cm^2	kg/cm2
1146	inH_2O	inH2O
1147	$inH_2O(4°C)$	inH2O
1148	$inH_2O(68°F)$	inH2O
1149	mmH_2O	mmH2O
1150	$mmH_2O(4°C)$	mmH2O
1151	$mmH_2O(68°F)$	mmH2O
1152	ftH_2O	ftH2O
1153	$ftH_2O(4°C)$	ftH2O
1154	$ftH_2O(68°F)$	ftH2O
1155	inHg	inHg
1156	inHg(0°C)	inHg
1157	mmHg	mmHg
1158	mmHg(0°C)	mmHg
1318	g/s	g/s
1319	g/min	g/m
1320	g/h	g/h
1322	kg/s	kg/s
1323	kg/min	kg/m
1324	kg/h	kg/h
1325	kg/d	kg/d
1327	t/min	t/m
1328	t/h	t/h
1329	t/d	t/d
1330	lb/s	lb/s
1331	lb/min	lb/m
1332	lb/h	lb/h
1333	lb/d	lb/d
1335	STon/min	STon/m
1336	STon/h	STon/h
1337	STon/d	STon/d
1340	LTon/h	LTon/h
1341	LTon/d	LTon/d

Index	Unit	Display on the LCD
1347	m^3/s	m3/s
1348	m^3/min	m3/m
1349	m^3/h	m3/h
1350	m^3/d	m3/d
1351	L/s	L/s
1352	L/min	L/m
1353	L/h	L/h
1355	ML/d	ML/d
1356	CFS	CFS
1357	CFM	CFM
1358	CFH	CFH
1359	ft^3/d	ft3/d
1360	SCFM	SCFM
1361	SCFH	SCFH
1362	gal/s	gal/s
1363	GPM	GPM
1364	gal/h	gal/h
1365	gal/d	gal/d
1366	Mgal/d	Mgal/d
1367	ImpGal/s	IGal/s
1368	ImpGal/min	IGal/m
1369	ImpGal/h	IGal/h
1370	ImpGal/d	IGal/d
1371	bbl/s	bbl/s
1372	bbl/min	bbl/m
1373	bbl/h	bbl/h
1374	bbl/d	bbl/d
1524	Nm^3/h	Nm3/h
1525	Nm^3/d	Nm3/d
1529	Sm^3/h	Sm3/h
1530	Sm^3/d	Sm3/d
1534	NL/h	NL/h
1537	SL/s	SL/s
1538	SL/min	SL/min
1539	SL/h	SL/h
1541	Paa	Paa
1542	Pag	Pag
1543	GPaa	GPaa
1544	GPag	GPag
1545	MPaa	MPaa
1546	MPag	MPag
1547	kPaa	kPaa
1548	kPag	kPag
1549	mPaa	mPaa
1550	mPag	mPag
1551	μPaa	uPaa
1552	μPag	uPag
1553	hPaa	hPaa
1554	hPag	hPag
1555	g/cm^2a	g/cm2a
1556	g/cm^2g	g/cm2g
1557	kg/cm^2a	kg/cm2a
1558	kg/cm^2g	kg/cm2g

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Index	Unit	Display on the LCD
1559	inH2Oa	inH2Oa
1560	inH2Og	inH2Og
1561	inH2Oa(4°C)	inH2Oa
1562	inH2Og(4°C)	inH2Og
1563	inH2Oa(68°F)	inH2Oa
1564	inH2Og(68°F)	inH2Og
1565	mmH2Oa	mmH2Oa
1566	mmH2Og	mmH2Og
1567	mmH2Oa(4°C)	mmH2Oa
1568	mmH2Og(4°C)	mmH2Og
1569	mmH2Oa(68°F)	mmH2Oa
1570	mmH2Og(68°F)	mmH2Og
1571	ftH2Oa	ftH2Oa
1572	ftH2Og	ftH2Og
1573	ftH2Oa(4°C)	ftH2Oa
1574	ftH2Og(4°C)	ftH2Og
1575	ftH2Oa(68°F)	ftH2Oa
1576	ftH2Og(68°F)	ftH2Og
1577	inHga	inHga
1578	inHgg	inHgg
1579	inHga(0°C)	inHga
1580	inHgg(0°C)	inHgg
1581	mmHga	mmHga
1582	mmHgg	mmHgg
1583	mmHga(0°C)	mmHga
1584	mmHgg(0°C)	mmHgg
1590	barg	Barg
1591	mbarg	mBarg
1597	bara	Bara
1598	MSCFD	MSCFD
1599	MMSCFD	MMSCFD
65520	SCFS	SCFS
65521	SCFD	SCFD

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6.6 AI Function Block

The AI function block is a unit of the software and executed according to the system schedule. During execution, it incorporates data from the SENSOR and Flow transducer block. After execution, it updates analog outputs and processes newly generated alarms. AI function blocks can provide a discrete output which shows the status of LO, LO_LO, HI, or HI_HI. In terms of function, there is no difference between the five AI function blocks provided in EJX multivariable transmitter.

6.6.1 Function Blocks

The AI function block, via the Channel, incorporates analog signals from the transducer block, performs scaling processing, filtering, low-cut, and alarm processing before outputting. It has the function to generate a discrete output. Figure 6.5 presents the AI function block.

6.6.2 Block Mode

The Block modes permitted for the AI function block are Automatic (Auto), Manual (Man), and Out of Service (O/S). When the Block mode of RB (Resource Block) is Out of Service (O/S), Actual is Out of Service (O/S) even if Automatic (Auto) or Manual (Man) is written to Target.

6.6.3 IO_OPTS

IO_OPTS is a parameter used to select whether options regarding input and output signals should be enabled or disabled. In the case of the AI function block, the only available option is “Low cutoff”. When enabling the low cut function for outputs, set this option.

6.6.4 STATUS_OPT

STATUS_OPT is a parameter to select options regarding the status of signals. The AI function block offers four options: Propagate Fault Forward, Uncertain if Limited, BAD if Limited, and Uncertain if Man mode.

Propagate Fault Forward

If the status from the sensor is Bad, Device failure or Bad, Sensor failure, propagate it to OUT without generating an alarm. The use of these sub-statuses in OUT is determined by this option. Through this option, the user may determine whether alarming (sending of an alert) will be done by the block or propagated downstream for alarming

Uncertain if Man mode

When the “Uncertain if Man” is enabled and the Actual mode is Man, the OUT signal status should be “Uncertain”.

6.6.5 OUT_D

OUT_D.value is “1” when the alarms selected by OUT_D_SEL occur.

OUT_D.status is linked OUT.status. OUT_D.value can be written the value form 0 to 15 when block mode is O/S or MAN mode. The OUT_D_SEL options are shown below.

High High Alarm (1): OUT_D.value will be “1” when HI_HI alarm occurs.
High Alarm (2): OUT_D.value will be “1” when HI alarm occurs.
Low Low Alarm (4): OUT_D.value will be “1” when LO_LO alarm occurs.
Low Alarm (8): OUT_D.value will be “1” when LO alarm occurs.

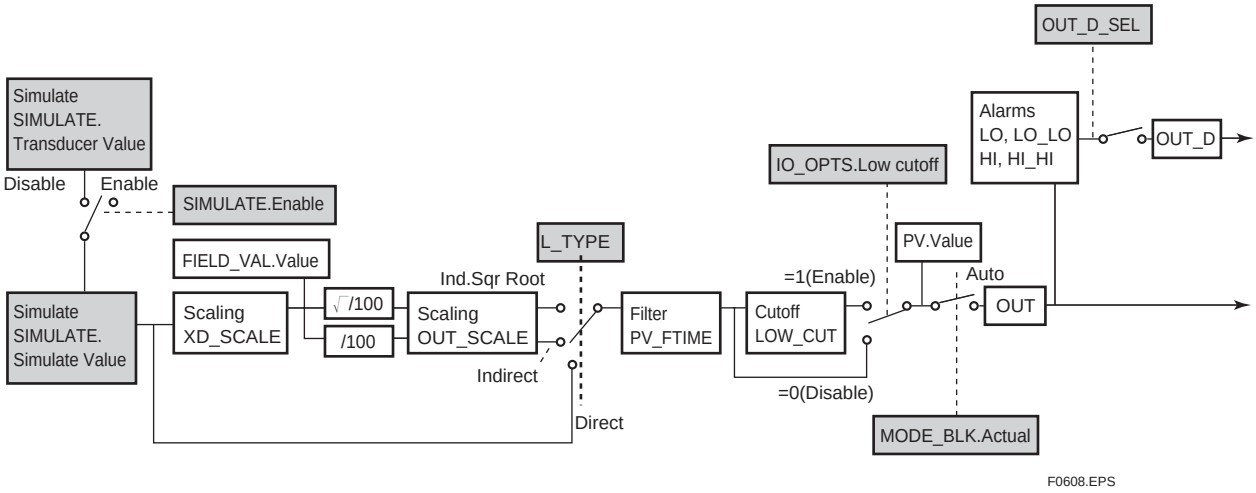

Figure 6.5 Diagram of the AI Functional Block

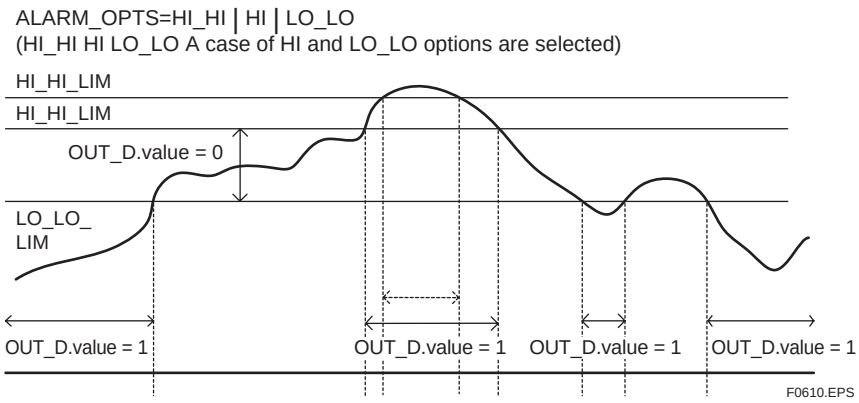

Figure 6.6 An Example of OUT_D.value

6.6.6 Basic Parameters of the AI Block

Parameter	Outline
OUT	Shows output value and status. When the Block mode is Man and O/S, the value is held.
SIMULATE	Used for simulation. It sets the value and status arbitrarily from the transducer. Use this parameter for loop checking. Refer to 7.3 Simulation Function
XD_SCALE	Sets the range of inputs from the transducer block that corresponds to 0% and 100% in the AI function block. Also sets the unit of the range, inputs values that correspond to 0% and 100%, and four decimal values.
OUT_SCALE	Sets the range, unit, and digit of the output scale.
CHANNEL	Selects the signal which is calculated in SENSOR Transducer Block. The relation between the signals and channels are shown below; Channel 1: PRIMARY VALUE (differential pressure) Channel 2: SECONDARY VALUE (H-side static pressure) Channel 3: TERTIARY VALUE (L-side static pressure) Channel 4: EXT_TEMP_VALUE(external temperature) Channel 5: FLOW_VALUE(flow) Channel 6: CAP_TEMP_VAL (capsule temperature) Channel 7: AMP_TEMP_VAL (amplifier temperature) Channel 8: FLG_TEMP_VAL (flange temperature, option code: /DG1) Flow value(channel 5) can be assigned to only one AI block at one time. Other variables can be assigned to one or more AI blocks simultaneously.
L_TYPE	The operation function of the AI function block can be selected from Direct, Indirect Linear, or Indirect SQRT: Direct : The Signal from the transducer block is directly output by filtering only, but without scaling or square root extraction. Indirect Linear : Values scaled according to the range settings of XD_SCALE and OUT_SCALE are output. Indirect SQRT : The square root extraction is performed to the values scaled according to the range settings of XD_SCALE. The square root values are scaled and output according to the range settings of OUT_SCALE.
LOW_CUT	When the output value is smaller than the value set by this parameter, the output value is 0. To enable the low-cut function, this parameter must be enabled in IO_OPTS. The setting is in an engineering unit of OUT_SCALE.

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7. IN-PROCESS OPERATION

This chapter describes the procedure performed when changing the operation of the function block of the EJX multivariable transmitter in process.

7.1 Mode Transition

When the function block mode is changed to Out_Of_Service, the function block pauses and a block alarm is issued.

When the function block mode is changed to Manual, the function block suspends updating of output values. In this case alone, it is possible to write a value to the OUT parameter of the block for output. Note that no parameter status can be changed.

7.2 Generation of Alarm

7.2.1 Indication of Alarm

When the self-diagnostics function indicates that a device is faulty, an alarm (device alarm) is issued from the resource block. When an error (block error) is detected in each function block or an error in the process value (process alarm) is detected, an alarm is issued from each block. If an LCD indicator is installed, the error number is displayed as AL.XX. If two or more alarms are issued, multiple error numbers are displayed.
For details of ALARM, refer to Section 8.2.

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Figure 7.1 Error Identification on Indicator

7.2.2 Alarms and Events

The following alarms or events can be reported by the EJX multivariable transmitter if Link object and VCR static entry are set.

Analog Alerts (Generated when a process value exceeds threshold)
- By AI Block: Hi-Hi Alarm, Hi Alarm, Low Alarm, Low-Low Alarm

Discret Alerts (Generated when an abnormal condition is detected)
- By Resource Block: Block Alarm, Write Alarm
- By Transducer Block: Block Alarm, Diagnostic Alarm (option code: /DG1)
- By AI, SC, IT, IS, AR and PID Blocks: Block Alarm

Update Alerts (Generated when an important (restorable) parameter is updated)
- By Resource Block: Update Event
- By Transducer Block: Update Event
- By AI, SC, IT, IS, AR and PID Blocks: Update Event

An alert has following structure:

Table 7.1 Alert Object

Subindex			Parameter Name	Explanation
Analog Alert	Discrete Alert	Update Alert		
1	1	1	Block Index	Index of block from which alert is generated
2	2	2	Alert Key	Alert Key copied from the block
3	3	3	Standard Type	Type of the alert
4	4	4	Mfr Type	Alert Name identified by manufacturer specific DD
5	5	5	Message Type	Reason of alert notification
6	6	6	Priority	Priority of the alarm
7	7	7	Time Stamp	Time when this alert is first detected
8	8		Subcode	Enumerated cause of this alert
9	9		Value	Value of referenced data
10	10		Relative Index	Relative index of referenced data
		8	Static Revision	Value of static revision (ST_REV) of the block
11	11	9	Unit Index	Unit code of referenced data

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7.3 Simulation Function

There are two simulation functions in EJX multivariable transmitter; one is the function commonly offered in FOUNDATION Fieldbus products to simulate input of each function block for loop check, and the other is the flow simulation function to simulate measured inputs for checking the result of flow calculation.

The simulation function described in this section is the former one. For flow simulation function, see '6.3.6 Simulation Function.'

The simulation function simulates the input of a function block and lets it operate as if the data was received from the transducer block. It is possible to conduct testing for the downstream function blocks or alarm processes.

A SIMULATE_ENABLE switch is mounted in the amplifier. This is to prevent the accidental operation of this function. When this is switched on, simulation is enabled. (See Figure 7.2.) To initiate the same action from a remote terminal, if REMOTE LOOP TEST SWITCH is written to the SIM_ENABLE_MSG parameter (index 1044) of the resource block, the resulting action is the same as is taken when the above switch is on. Note that this parameter value is lost when the power is turned OFF. In simulation enabled status, an alarm is generated from the resource block, and other device alarms will be masked; for this reason the simulation must be disabled immediately after using this function.

The SIMULATE parameter of AI block consists of the elements listed in Table 7.2 below.

Table 7.2 SIMULATE Parameter

Sub-index	Parameters	Description
1	Simulate Status	Sets the data status to be simulated.
2	Simulate Value	Sets the value of the data to be simulated.
3	Transducer Status	Displays the data status from the transducer block. It cannot be changed.
4	Transducer Value	Displays the data value from the transducer block. It cannot be changed.
5	Simulate En/Disable	Controls the simulation function of this block. 1: Simulation disabled (standard) 2: Simulation started

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When Simulate En/Disable in Table 7.2 above is set to 2, the applicable function block uses the simulation value set in this parameter instead of the data from the transducer block. This setting can be used for propagation of the status to the trailing blocks, generation of a process alarm, and as an operation test for trailing blocks.

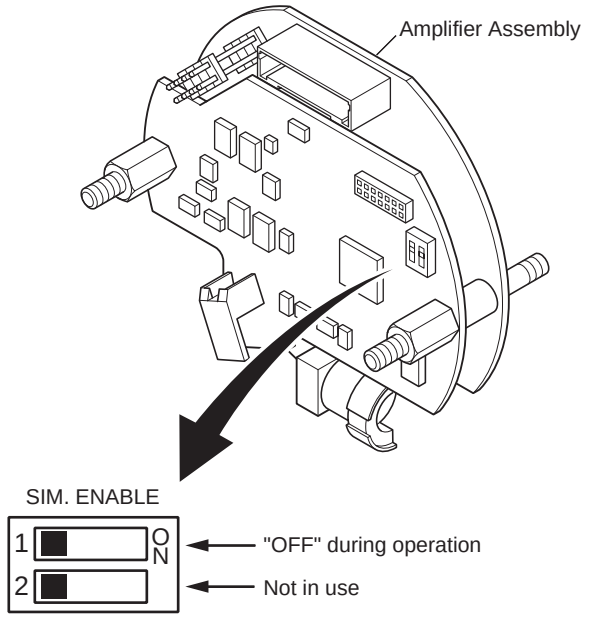

Figure 7.2 SIMULATE_ENABLE Switch Position

8. DEVICE INFORMATION

8.1 DEVICE STATUS

Device status for the EJX are indicated by using parameter DEVICE_STATUS_1 to DEVICE_STATUS_8 (index 1045 to 1052) in Resource Block.

Table 8.1 Contents of DEVICE_STATUS_1 (index 1045)

Hexadecimal	Display through DD	Description
0x00800000	Sim.enable Jmpr On	SIMULATE_ENABLE switch is ON.
0x00400000	RB in O/S mode (AL.21)	Resource Block is in O/S mode.
0x00080000	AMP Module Failure 2 (AL.03)	AMP module failure
0x00008000	LINK OBJ. 1/17/33 not open	Link object 1 is not open.
0x00004000	LINK OBJ. 2/18/34 not open	Link object 2 is not open.
0x00002000	LINK OBJ. 3/19/35 not open	Link object 3 is not open.
0x00001000	LINK OBJ. 4/20/36 not open	Link object 4 is not open.
0x00000800	LINK OBJ. 5/21/37 not open	Link object 5 is not open.
0x00000400	LINK OBJ. 6/22/38 not open	Link object 6 is not open.
0x00000200	LINK OBJ. 7/23/39 not open	Link object 7 is not open.
0x00000100	LINK OBJ. 8/24/40 not open	Link object 8 is not open.
0x00000080	LINK OBJ. 9/25 not open	Link object 9 is not open.
0x00000040	LINK OBJ. 10/26 not open	Link object 10 is not open.
0x00000020	LINK OBJ. 11/27 not open	Link object 11 is not open.
0x00000010	LINK OBJ. 12/28 not open	Link object 12 is not open.
0x00000008	LINK OBJ. 13/29 not open	Link object 13 is not open.
0x00000004	LINK OBJ. 14/30 not open	Link object 14 is not open.
0x00000002	LINK OBJ. 15/31 not open	Link object 15 is not open.
0x00000001	LINK OBJ. 16/32 not open	Link object 16 is not open.

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Table 8.2 Contents of DEVICE_STATUS_2 (index 1046)

Hexadecimal	Display through DD	Description
0x80000000	Pressure Sensor Failure 1 (AL-01)	Pressure Sensor problem
0x40000000	Pressure Sensor Failure 2 (AL-01)	Pressure Sensor problem
0x20000000	Pressure Sensor Failure 3 (AL-01)	Pressure Sensor problem
0x10000000	Pressure Sensor Failure 4 (AL-01)	Pressure Sensor problem
0x08000000	Capsule Temp Sensor Failure (AL-01)	Capsule Temperature Sensor problem
0x04000000	Capsule EEPROM Failure 1 (AL-01)	Capsule memory problem
0x02000000	Capsule EEPROM Failure 2 (AL-01)	Capsule memory problem
0x00800000	Amp Temp Sensor Failure (AL-02)	Amplifier Temperature Sensor problem
0x00400000	Amp EEPROM Failure 1 (AL-02)	Amplifier memory problem
0x00200000	Amp EEPROM Failure 2 (AL-02)	Amplifier memory problem
0x00100000	CPU Board Failure 1 (AL-02)	Amplifier problem
0x00080000	CPU Board Failure 2 (AL-02)	Amplifier problem
0x00040000	CPU Board Failure 3 (AL-02)	Amplifier problem
0x00020000	CPU Board Failure 4 (AL-02)	Amplifier problem
0x00008000	CPU Board Failure 5 (AL-02)	Amplifier problem
0x00004000	CPU Board Failure 6 (AL-02)	Amplifier problem
0x00000800	External Temp Sensor Failure (AL-03)	External temperature sensor disconnection

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Table 8.3 Contents of DEVICE_STATUS_3 (index 1047)

Hexadecimal	Display through DD	Description
0x80000000	Diff Pressure outside Range Limit (AL-10)	Input Pressure is outside measurement range limit of capsule
0x40000000	Static Pressure outside Range Limit (AL-11)	Static Pressure exceeds limit
0x20000000	Capsule Temp outside Range Limit (AL-12)	Capsule Temperature is out of range
0x10000000	Amp Temp outside Range Limit (AL-13)	Amplifier Temperature is out of range
0x08000000	External Temp outside Range Limit (AL-14)	External temperature is out of range
0x00008000	The execution of AI1 is not ready (AL-20)	AI1 is not ready
0x00004000	AI1 Non-Scheduled (AL-21)	AI1 block is not scheduled
0x00002000	AI2 Non-Scheduled (AL-22)	AI2 block is not scheduled
0x00001000	AI3 Non-Scheduled (AL-23)	AI3 block is not scheduled
0x00000800	AI4 Non-Scheduled (AL-24)	AI4 block is not scheduled
0x00000400	AI5 Non-Scheduled (AL-25)	AI5 block is not scheduled

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Table 8.4 Contents of DEVICE_STATUS_4 (index 1048)

Hexadecimal	Display through DD	Description
0x80000000	AI1 Hi Hi Alarm occurs (AL-30)	Hi_Hi Alarm occurs in AI1 Function block
0x40000000	AI1 Lo Lo Alarm occurs (AL-30)	Lo_Lo Alarm occurs in AI1 Function block
0x20000000	AI2 Hi Hi Alarm occurs (AL-31)	Hi_Hi Alarm occurs in AI2 Function block
0x10000000	AI2 Lo Lo Alarm occurs (AL-31)	Lo_Lo Alarm occurs in AI2 Function block
0x08000000	AI3 Hi Hi Alarm occurs (AL-32)	Hi_Hi Alarm occurs in AI3 Function block
0x04000000	AI3 Lo Lo Alarm occurs (AL-32)	Lo_Lo Alarm occurs in AI3 Function block
0x02000000	AI4 Hi Hi Alarm occurs (AL-33)	Hi_Hi Alarm occurs in AI4 function block
0x01000000	AI4 Lo Lo Alarm occurs (AL-33)	Lo_Lo Alarm occurs in AI4 function block
0x00800000	AI5 Hi Hi Alarm occurs (AL-34)	Hi_Hi Alarm occurs in AI5 function block
0x00400000	AI5 Lo Lo Alarm occurs (AL-34)	Lo_Lo Alarm occurs in AI5 function block
0x00200000	PID Hi Hi Alarm occurs (AL-35)	Hi_Hi Alarm occurs in PID Function block
0x00100000	PID Lo Lo Alarm occurs (AL-35)	Lo_Lo Alarm occurs in PID Function block
0x00008000	RB in O/S mode (AL-40)	Resource Block is in O/S mode
0x00004000	Sensor TB in O/S mode (AL-41)	Sensor TB is in O/S mode
0x00001000	Flow TB in O/S mode (AL-42)	FLOW TB is in O/S mode
0x00000800	AI1 in O/S mode (AL-43)	AI1 block is in O/S mode
0x00000400	AI2 in O/S mode (AL-44)	AI2 block is in O/S mode
0x00000200	AI3 in O/S mode (AL-45)	AI3 block is in O/S mode
0x00000100	AI4 in O/S mode (AL-46)	AI4 block is in O/S mode
0x00000080	AI5 in O/S mode (AL-47)	AI5 block is in O/S mode

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Table 8.5 Contents of DEVICE_STATUS_5 (index 1049)

Hexadecimal	Display through DD	Description
0x80000000	Diff Pressure Span Trim Error (AL-50)	Trimming range error for differential pressure span
0x40000000	Diff Pressure Zero Trim Error (AL-50)	Trimming range error for differential pressure zero
0x20000000	Static Pressure Span Trim Error (AL-51)	Trimming range error for static pressure span
0x10000000	Static Pressure Zero Trim Error (AL-51)	Trimming range error for static pressure zero
0x08000000	External Temp Span Trim Error (AL-52)	Trimming range error for external temperature span
0x04000000	External Temp Zero Trim Error (AL-52)	Trimming range error for external temperature zero

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Table 8.6 Contents of DEVICE_STATUS_6 (index 1050)

Hexadecimal	Display through DD	Description
0x80000000	PID in O/S mode (AL-70)	PID block is in O/S mode
0x40000000	PID in MAN mode (AL-70)	PID block is in MAN mode
0x20000000	PID Non-Schduled (AL-70)	PID block is not Scheduled
0x10000000	SC in O/S mode (AL-71)	SC block is in O/S mode
0x08000000	SC in MAN mode (AL-71)	SC block is in MAN mode
0x04000000	SC Non-Schduled (AL-71)	SC block is not scheduled
0x02000000	IT in O/S mode (AL-72)	IT block is in O/S mode
0x01000000	IT in MAN mode (AL-72)	IT block is in MAN mode
0x00800000	IT Non-Schduled (AL-72)	IT block is not scheduled
0x00400000	IS in O/S mode (AL-73)	IS block is in O/S mode
0x00200000	IS in MAN mode (AL-73)	IS block is in MAN mode
0x00100000	IS Non-Schduled (AL-73)	IS block is not scheduled
0x00080000	AR in O/S mode (AL-74)	AR block is in O/S mode
0x00040000	AR in MAN mode (AL-74)	AR block is in MAN mode
0x00020000	AR Non-Schduled (AL-74)	AR block is not scheduled
0x00000002	LCD Display Outside Range Limit (AL-79)	Displayed value exceeds limit
0x00000001	LCD Display Config Error (AL-79)	Specified settings for Display do not meet the conditions.

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Table 8.7 Contents of DEVICE_STATUS_7 (index 1051)

Hexadecimal	Display through DD	Description
0x80000000	Sensor TB Simulation Active (AL-80)	Simulation function of Sensor TB is active
0x40000000	Flow TB Configuration Error (AL-81)	Configuration error occurs in Flow TB
0x20000000	Flow TB Algorithm Error 1 (AL-82)	Configuration error
0x10000000	Flow TB Algorithm Error 2 (AL-82)	Configuration error
0x08000000	Flow TB Algorithm Error 3 (AL-82)	Configuration error
0x04000000	Flow TB Algorithm Error 4 (AL-82)	Configuration error
0x02000000	Flow TB Algorithm Error 5 (AL-82)	Configuration error
0x01000000	Flow TB Algorithm Error 6 (AL-82)	Configuration error
0x00800000	Flow TB Check Sum Error (AL-83)	Precise flow setting CHECK SUM error
0x000040000*	Flg Temp High Alarm (AL-87)	Flange Temperature High Alarm occurs.
0x000002000*	Flg Temp Low Alarm (AL-87)	Flange Temperature Low Alarm occurs.
0x000001000*	Outside Diagonosis Range (AL-89)	VALUE_DPAVG is outside range.
0x000000800*	Invalid Ref fDP (AL-88)	VALUE_FDP under normal conditions is not up to the reference fluctuation level required to blockage detection.
0x000000400*	Invalid Ref fSPl (AL-88)	VALUE_FSPL under normal conditions is not up to the reference fluctuation level required to blockage detection.
0x000000200*	Invalid Ref fSPh (AL-88)	VALUE_FSPH under normal conditions is not up to the reference fluctuation level required to blockage detection.
0x000000100*	Invalid Ref BlkF (AL-88)	VALUE_BLKF under normal conditions is not up to the reference fluctuation level required to blockage detection.
0x000000080*	B Blocking (AL-89)	B Blocking (both- side blockage) is detected.
0x000000040*	High Side Blocking (AL-89)	High-pressure-side blockage is detected.
0x000000020*	Low Side Blocking (AL-89)	Low-pressure-side blockage is detected.
0x000000010*	Large Fluctuation of High Side (AL-89)	Pressure fluctuation amplitude of high-pressure side is large.
0x000000008*	Large Fluctuation of Low Side (AL-89)	Pressure fluctuation amplitude of low-pressure side is large.
0x000000004*	A Blocking (AL-89)	A Blocking (single-side blockage) is detected.

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*: option code /DG1

Table 8.8 Contents of DEVICE_STATUS_8 (index 1052)

Hexadecimal	Display through DD	Description
0x80000000	AI1 in Simulate active (AL-90)	Simulation function of AI1 block is active
0x40000000	AI2 in Simulate active (AL-91)	Simulation function of AI2 block is active
0x20000000	AI3 in Simulate active (AL-92)	Simulation function of AI3 block is active
0x10000000	AI4 in Simulate active (AL-93)	Simulation function of AI4 block is active
0x08000000	AI5 in Simulate active (AL-94)	Simulation function of AI5 block is active
0x04000000	AI1 in MAN mode (AL-95)	AI1 block is in MAN mode
0x02000000	AI2 in MAN mode (AL-96)	AI2 block is in MAN mode
0x01000000	AI3 in MAN mode (AL-97)	AI3 block is in MAN mode
0x00800000	AI4 in MAN mode (AL-98)	AI4 block is in MAN mode
0x00400000	AI5 in MAN mode (AL-99)	AI5 block is in MAN mode

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8.2 Status of each parameter in failure mode

Following tables summarize the value of EJX parameters when LCD display indicates an Alaram.

Table 8.9 Action of each parameters in failure mode related Resource block and Sensor Transducer block

LCD Display	Cause of Alarm	Resource of Alarm	SENSOR TB							FLOW TB
		BLOCK_ERR	BLOCK_ERR	XD_ERROR	PV.STATUS	SV.STATUS TV.STATUS	EXT_TEMP_ VAL.STATUS	CAP_TEMP_ VAL.STATUS	AMP_TEMP_ VAL.STATUS	FLOW_ VALUE.STATUS
AL.01 CAP.ERR	Pressure Sensor problem	—	other	I/O Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure
	Capsule Temperature Sensor	—	other	I/O Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure
	Capsule memory problem	Lost NV Date	other	I/O Failure	BAD:Device Failure	BAD:Device Failure	BAD:Sensor Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure
AL.02 AMP.ERR	Amplifier Temperature Sensor	—	other	Electronics Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure	BAD:Sensor Failure
	Amplifier memory problem	Lost NV Date Lost Static Data	other	Electronics Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure
	Amplifier problem	—	other	Electronics Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure	BAD:Device Failure
AL.03 ET ERR	External temperature sensor disconnection	—	other	Mechanical Failure	—	—	BAD:Device Failure *1	—	—	BAD:Device Failure *1
AL.10 PRESS	Input Pressure is outside measurement range limit of capsule	—	—	—	UNCERTAIN: Sensor Conversion not Accurate	UNCERTAIN Subnormal	—	—	—	UNCERTAIN: Sensor Conversion not Accurate
AL.11 ST.PRSS	Static pressure is outside the measurement range limit of capsule	—	—	—	UNCERTAIN Subnormal	UNCERTAIN: Sensor Conversion not Accurate	—			UNCERTAIN: Sensor Conversion not Accurate
AL.12 CAP.TMP	Capsule Temperature is out of range	—	—	—	UNCERTAIN Subnormal	UNCERTAIN Subnormal	—	UNCERTAIN: Sensor Conversion not Accurate	—	UNCERTAIN: Sensor Conversion not Accurate
AL.13 AMP.TMP	Amplifier temperature is outside the measurement range limit	—	—	—	—	—	—	—	UNCERTAIN: Sensor Conversion not Accurate	UNCERTAIN: Sensor Conversion not Accurate
AL.14 EXT.TMP	External temperature is outside of the range limit.	—	—	—	—	—	UNCERTAIN: Sensor Conversion not Accurate	—	—	UNCERTAIN: Sensor Conversion not Accurate
AL.20 NOT.RDY	No communication is found with LAS.	—	—	—	—	—	—	—	—	—
AL.40 RS O/S	RESOURCE block is in O/S mode	Out of Service	—	—	BAD: Non-specific	BAD: Non-specific	BAD: Non-specific	BAD: Non-specific	BAD: Non-specific	BAD: Non-specific
AL.41 TB O/S	SENSOR transducer block is in O/S mode	—	Out of Service	Out of Service	BAD:Out of Service	BAD:Out of Service	BAD:Out of Service	BAD:Out of Service	BAD:Out of Service	—
AL.42 TB O/S	FLOW transducer block is in O/S mode	—	—	—	—	—	—	—	—	BAD:Out of Service
AL.50 P.SDEV P.ZDEV	Trimming range error for differential pressure span	—	other	Calibration error	UNCERTAIN: Engineering Unit Range Violation	—	—	—	—	—
AL.51 SP.SDEV SP.ZDEV	Trimming range error for static pressure span	—	other	Calibration error	—	UNCERTAIN: Engineering Unit Range Violation	—	—	—	—
AL.52 ET.SDEV ET.ZDEV	Trimming range error for External temperature span	—	other	Calibration error	—	—	UNCERTAIN: Engineering Unit Range Violation	—	—	—
AL.80 SNR.SIM	Simulation mode	—	other	Simulation Enabled	—	—	—	—	—	—
AL.81 FLW.CFG	Flow TBconfiguration error	—	—	—	—	—	—	—	—	—
AL.82 FLW.ALG	Flow correction coefficient error	—	—	—	—	—	—	—	—	BAD:Configu-ration Error
AL.83 FLW.SUM	Flow check sum error	—	—	—	—	—	—	—	—	BAD:Configu-ration Error

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*1: Good(NC) Non-specific for when Fall Back mode is selected for External Temperature and while fixed temperature is output.

Table 8.10 Action of each parameters in failure mode related LCD display

ALARM Display	Cause of Alarm	LCD TB	
		BLOCK_ERR	XD_ERROR
AL.79 LCD.RNG LCD.CFG	Displayed value exceeds limit or LCD configuration error	—	—

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Table 8.11 Action of each parameters in failure mode related Function block

ALARM Display	Cause of Alarm	Object block	BLOCK_ERR	OUT.STATUS
AL.21 NO.SCHD	AI1 block is not scheduled	AI1	HOLD	HOLD
AL.22 NO.SCHD	AI2 block is not scheduled	AI2		
AL.23 NO.SCHD	AI3 block is not scheduled	AI3		
AL.24 NO.SCHD	AI4 block is not scheduled	AI4		
AL.25 NO.SCHD	AI5 block is not scheduled	AI5		
AL.30 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in AI1 Function block	AI1	—	Depends on specified High High(Low Low) Priority (*1)
AL.31 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in AI2 Function block	AI2	—	Depends on specified High High(Low Low) Priority (*1)
AL.32 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in AI3 Function block	AI3	—	Depends on specified High High(Low Low) Priority (*1)
AL.33 HI.HI LO.LO	Hi_Hi or Lo_Lo Alarm occurs in PID Function block	PID	—	Depends on specified High High(Low Low) Priority (*1)
AL.33 HI.HI LO.LO	HI_HI or LO_LO Alarm occurs in AI4 block	AI4	—	Depends on specified High High(Low Low) Priority (*1)
AL.34 HI.HI LO.LO	HI_HI or LO_LO occurs in AI5 block	AI5	—	Depends on specified High High(Low Low) Priority (*1)
AL.43 AI O/S	AI1 block is O/S mode	AI1	Out-of-Service	BAD-Out of Service
AL.44 AI O/S	AI2 block is O/S mode	AI2		
AL.45 AI O/S	AI3 block is O/S mode	AI3		
AL.46 AI O/S	AI4 block is O/S mode.	AI4		
AL.47 AI O/S	AI5 block is O/S mode.	AI5		
AL.70 PID O/S PID.MAN NO.SCHD	PID block is not scheduled or is MAN, O/S mode	PID	Depends on cause of Alarm	Depends on cause of Alarm
AL.71 SC O/S SC MAN NO.SCHD	SC block is not scheduled or is MAN, O/S mode	SC	Depends on cause of Alarm	Depends on cause of Alarm
AL.72 IT O/S IT MAN NO.SCHD	IT block is not scheduled or is MAN, O/S mode	IT	Depends on cause of Alarm	Depends on cause of Alarm
AL.73 IS O/S IS MAN NO.SCHD	IS block is not scheduled or is MAN, O/S mode	IS	Depends on cause of Alarm	Depends on cause of Alarm
AL.74 AR O/S AR MAN NO.SCHD	AR block is not scheduled or is MAN, O/S mode	AR	Depends on cause of Alarm	Depends on cause of Alarm
AL.90 AI SML	Simulation function of AI1 block is active	AI1	Simulate Active	Specified Status
AL.91 AI SML	Simulation function of AI2 block is active	AI2	Simulate Active	Specified Status
AL.92 AI SML	Simulation function of AI3 block is active	AI3	Simulate Active	Specified Status
AL.93 AI SML	Simulation function of AI4 block is active	AI4	Simulate Active	Specified Status
AL.94 AI SML	Simulation function of AI5 block is active	AI5	Simulate Active	Specified Status
AL.95 AI MAN	AI1 block is MAN mode	AI1	—	Depends on setting condition of STATUS_OPT Limit Status:Constant
AL.96 AI MAN	AI2 block is MAN mode	AI2	—	Depends on setting condition of STATUS_OPT Limit Status:Constant
AL.97 AI MAN	AI3 block is MAN mode	AI3	—	Depends on setting condition of STATUS_OPT Limit Status:Constant
AL.98 AI MAN	AI4 block is MAN mode	AI4	—	Depends on setting condition of STATUS_OPT Limit Status:Constant
AL.99 AI MAN	AI5 block is MAN mode	AI5	—	Depends on setting condition of STATUS_OPT Limit Status:Constant

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(*1) Priority:
0 = the associated alert will never occur.
1 = the associated alert is not sent as a notification. If the priority is above 1, then the alert must be reported.
2 = Block alarm and update event have a fixed priority of 2.
3-7 = advisory alarms (PV.STATUS = Active Advisory Alarm)
8-15 = critical alarms (PV.STATUS = Active Critical Alarm)

Table 8.12 Action of each parameters in failure mode related Advanced Diagnostic (option code: /DG1)

ALARM Display	Cause of Alarm	SENSOR Transducer block		
		DIAG_ERR		PV.STATUS SV.STATUS TV.STATUS (*1)
		Hexadecimal	Display through DD	
AL.87 FLG HI	Flange Temperature High Alarm occurs.	0x4000	Flg Temp High Alarm	
AL.87 FLG LO	Flange Temperature Low Alarm occurs.	0x2000	Flg Temp Low Alarm	
AL.88 INVR.DP	Reference fDP value is invalid.	0x0800	Invalid Ref fDP	
AL.88 INVR.SL	Reference fSPl value is invalid.	0x0400	Invalid Ref fSPl	
AL.88 INVR.SH	Reference fSPh value is invalid.	0x0200	Invalid Ref fSPh	
AL.88 INVR.F	Reference BlkF value is invalid.	0x0100	Invalid Ref BlkF	
AL.89 B BLK	B Blocking is detected.	0x0080	B Blocking	UNCERTAIN:Non Specific
AL.89 H BLK	High-pressure-side Blocking is detected.	0x0040	High Side Blocking	UNCERTAIN:Non Specific
AL.89 L BLK	Low-pressure-side Blocking is detected.	0x0020	Low Side Blocking	UNCERTAIN:Non Specific
AL.89 H LRG	Large Fluctuation of High Side.	0x0010	Large Fluctuation of High Side	UNCERTAIN:Non Specific
AL.89 L LRG	Large Fluctuation of Low Side.	0x0008	Large Fluctuation of Low Side	UNCERTAIN:Non Specific
AL.89 A BLK	A Blocking is detected.	0x0004	A Blocking	UNCERTAIN:Non Specific
AL.89 DIAG.OV	DPavg is outside range.	0x1000	Outside Diagonosis Range	

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(*1): These settings depend on bit 15 in DIAG_OPTION.

9. PARAMETER LISTS

Note: The Write Mode column contains the modes in which each parameter is write enabled.
O/S: Write enabled in O/S mode.
MAN: Write enabled in Man mode and O/S mode.
AUTO: Write enabled in Auto mode, Man mode, and O/S mode.

9.1 Resource Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	1000	Block Header	TAG:“RS”	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	1001	ST_REV	–	–	The revision level of the static data associated with the resource block. The revision value is incremented each time a static parameter value in this block is changed.
2	1002	TAG_DESC	Null	AUTO	The user description of the intended application of the block.
3	1003	STRATEGY	1	AUTO	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	1004	ALERT_KEY	1	AUTO	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	1005	MODE_BLK	AUTO	AUTO	The actual, target, permitted, and normal modes of the block.
6	1006	BLOCK_ERR	–	–	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	1007	RS_STATE	–	–	State of the resource block state machine.
8	1008	TEST_RW	Null	AUTO	Read/write test parameter-used only for conformance testing and simulation.
9	1009	DD_RESOURCE	Null	–	String identifying the tag of the resource which contains the Device Description for this resource.
10	1010	MANUFAC_ID	0x00594543	–	Manufacturer identification number-used by an interface device to locate the DD file for the resource.
11	1011	DEV_TYPE	14	–	Manufacturer’s model number associated with the resource-used by interface devices to locate the DD file for the resource.
12	1012	DEV_REV	1	–	Manufacturer revision number associated with the resource-used by an interface device to locate the DD file for the resource.
13	1013	DD_REV	1	–	Revision of the DD associated with the resource-used by an interface device to locate the DD file for the resource.
14	1014	GRANT_DENY	0	AUTO	Options for controlling access of host computer and local control panels to operating, tuning and alarm parameters of the block.
15	1015	HARD_TYPES	Scalar input	–	The types of hardware available as channel numbers. bit0: Scalar input bit1: Scalar output bit2: Discrete input bit3: Discrete output
16	1016	RESTART	–	–	Allows a manual restart to be initiated. Several degrees of restart are possible. They are 1: Run, 2: Restart resource, 3: Restart with initial value specified in FF functional spec. (*1), and 4: Restart processor. *1: FF-891 Foundation™ Specification Function Block Application Process Part 2.
17	1017	FEATURES	Soft write lock supported Report supported	–	Used to show supported resource block options.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
18	1018	FEATURE_SEL	Soft write lock supported Report supported	AUTO	Used to select resource block options defined in FEATURES. bit0: Scheduled bit1: Event driven bit2: Manufacturer specified
19	1019	CYCLE_TYPE	Scheduled	–	Identifies the block execution methods available for this resource.
20	1020	CYCLE_SEL	Scheduled	AUTO	Used to select the block execution method for this resource.
21	1021	MIN_CYCLE_T	3200 (100ms)	–	Time duration of the shortest cycle interval of which the resource is capable.
22	1022	MEMORY_SIZE	0	–	Available configuration memory in the empty resource. To be checked before attempting a download.
23	1023	NV_CYCLE_T	0	–	Interval between writing copies of nonvolatile parameters to non-volatile memory. Zero means never.
24	1024	FREE_SPACE	0	–	Percent of memory available for further configuration. EJX has zero which means a preconfigured resource.
25	1025	FREE_TIME	0	–	Percent of the block processing time that is free to process additional blocks. EJX does not support this.
26	1026	SHED_RCAS	640000 (2S)	AUTO	Time duration at which to give up on computer writes to function block RCas locations. Supported only with PID function.
27	1027	SHED_ROUT	640000 (2S)	AUTO	Time duration at which to give up on computer writes to function block ROut locations. Supported only with PID function.
28	1028	FAULT_STATE	1	–	Condition set by loss of communication to an output block, failure promoted to an output block or a physical contact. When fail-safe condition is set, then output function blocks will perform their FSAFE actions.
29	1029	SET_FSTATE	1	AUTO	Allows the fail-safe condition to be manually initiated by selecting Set.
30	1030	CLR_FSTATE	1	AUTO	Writing a Clear to this parameter will clear the device fail-safe state if the field condition, if any, has cleared.
31	1031	MAX_NOTIFY	3	–	Maximum number of unconfirmed notify messages possible.
32	1032	LIM_NOTIFY	3	AUTO	Maximum number of unconfirmed alert notify messages allowed.
33	1033	CONFIRM_TIM	5000 (ms)	AUTO	The minimum time between retries of alert reports.
34	1034	WRITE_LOCK	Not locked	AUTO	If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated
35	1035	UPDATE_EVT	–	–	This alert is generated by any change to the static data.
36	1036	BLOCK_ALM	–	–	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
37	1037	ALARM_SUM	Enable	–	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
38	1038	ACK_OPTION	0xFFFF	AUTO	Selection of whether alarms associated with the block will be automatically acknowledged.
39	1039	WRITE_PRI	0	AUTO	Priority of the alarm generated by clearing the write lock.
40	1040	WRITE_ALM	–	–	This alert is generated if the write lock parameter is cleared.
41	1041	ITK_VER	4	–	Version number of interoperability test by Fieldbus Foundation applied to EJX multivariable transmitter.
42	1042	SOFT_REV		–	EJX multivariable transmitter software revision number.
43	1043	SOFT_DESC		–	Yokogawa internal use.
44	1044	SIM_ENABLE_MSG	Null	AUTO	Software switch for simulation function.
45	1045	DEVICE_STATUS_1	0	–	Device status For details, refer to Table 8.1

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
46	1046	DEVICE_STATUS_2	0	–	Device status For details, refer to Table 8.2
47	1047	DEVICE_STATUS_3	0	–	Device status For details, refer to Table 8.3
48	1048	DEVICE_STATUS_4	0	–	Device status For details, refer to Table 8.4
49	1049	DEVICE_STATUS_5	0	–	Device status For details, refer to Table 8.5
50	1050	DEVICE_STATUS_6	0	–	Device status For details, refer to Table 8.6
51	1051	DEVICE_STATUS_7	0	–	Device status For details, refer to Table 8.7
52	1052	DEVICE_STATUS_8	0	–	Device status For details, refer to Table 8.8
53	1053	SOFTDWN_PROTECT	0x01	AUTO	Defines whether to accept software downloads. 0x01: Unprotected 0x02: Protected
54	1054	SOFTDWN_FORMAT	0x01	AUTO	Selects the software download method. 0x01: Standard
55	1055	SOFTDWN_COUNT	0	–	Indicates the number of times the internal FlashROM was erased.
56	1056	SOFTDWN_ACT_ AREA	0	–	Indicates the ROM number of the currently working FlashROM. 0: FlashROM #0 working 1: FlashROM #1 working
57	1057	SOFTDWN_MOD_REV	1,0,0,0,0,0,0,0	–	Indicates the software module revision.
58	1058	SOFTDWN_ERROR	0	–	Indicates the error during a software download. Refer Table A7.4.

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9.2 SENSOR Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2000	Block Header	TAG: “STB”	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	2001	ST_REV	–	–	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
2	2002	TAG_DESC	Null	AUTO	The user description of the intended application of the block
3	2003	STRATEGY	1	AUTO	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	2004	ALERT_KEY	1	AUTO	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	2005	MODE_BLK	AUTO	AUTO	The actual, target, permitted, and normal modes of the block.
6	2006	BLOCK_ERR	–	–	This parameter reflects the error status associated with hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	2007	UPDATE_EVT	–	–	This alert is generated by any change to the static data.
8	2008	BLOCK_ALM	–	–	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute.
9	2009	TRANSDUCER_ DIRECTORY	–	–	A directory that specifies the number and starting indices of the transducers.
10	2010	TRANSDUCER_ TYPE	100 (Standard Pressure with Calibration)	–	Identifies transducer.
11	2011	XD_ERROR	–	–	The error code in transducer. 0=No failure 18=Calibration error 20=Electronics failure 22=I/O failure
12	2012	COLLECTION_ DIRECTORY	–	–	A directory that specifies the number, starting indices, and DD Item Ids of the data collections in each transducer within a transducer block.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
13	2013	PRIMARY_ VALUE_TYPE	107: differential pressure	O/S	The type of measurement represented by primary value.
14	2014	PRIMARY_ VALUE	–	–	The measured value and status available to the function block.
15	2015	PRIMARY_ VALUE_RANGE	Range of capsule	–	The High and Low range limit values, engineering units code and the number of digits to the right of the decimal point to be used to display the primary value.
16	2016	CAL_POINT_HI	Max range	O/S	The highest calibrated value.
17	2017	CAL_POINT_LO	0	O/S	The lowest calibrated value.
18	2018	CAL_MIN_SPAN	Minimum span of capsule	–	The minimum calibration span value allowed.
19	2019	CAL_UNIT	kPa	–	The engineering unit for the calibrated values.
20	2020	SENSOR_TYPE	Silicon resonant	–	The type of sensor.
21	2021	SENSOR_ RANGE	Range of capsule	–	The High and Low range limit values, engineering units code and the number of digits to the right of the decimal point for the sensor.
22	2022	SENSOR_SN	Serial No.	–	Serial number.
23	2023	SENSOR_CAL_ METHOD	103: factory trim standard calibration	O/S	The method of the last sensor calibration. 100=volumetric 101=static weight 102=dynamic weight 103=factory trim standard calibration 104=user trim standard calibration 105=factory trim special calibration 106=user trim special calibration 255=others
24	2024	SENSOR_CAL_ LOC	–	O/S	Set/indicate the location of the last sensor calibration.
25	2025	SENSOR_CAL_ DATE	–	O/S	Set/indicate the date of the last sensor calibration.
26	2026	SENSOR_CAL_ WHO	–	O/S	Set/indicate the name of the person responsible for the last sensor calibration.
27	2027	SENSOR_ ISOLATOR_MTL	Unkown	–	Defines the construction material of the isolating diaphragms.
28	2028	SENSOR_FILL_ FLUID	Unkown	–	Defines the type of fluid used in the sensor.
29	2029	SECONDARY_ VALUE		–	Static pressure (high pressure side) value and status
30	2030	SECONDARY_ VALUE_UNIT	1545 (MPaa)	–	The engineering unit of static pressure (high pressure side). This unit is linked to XD_SCALE.unit of AI blocks
31	2031	CAL_ DEVIATION_HI	0	O/S	Deviation value for span adjustment.
32	2032	CAL_ DEVIATION_LO	0	O/S	Deviation value for zero adjustment.
33	2033	EXTERNAL_ ZERO_TRIM	0	O/S	Permission of external zero-adjustment
34	2034	PRIMARY_ VALUE_FTIME	2	O/S	Damping time constant for primary value
35	2035	TERTIARY_ VALUE		–	Value and status of static pressure at low side
36	2036	SP_VALUE_ TYPE	109 (absolute pressure)	O/S	Select the type of measurement for static pressure, absolute or gauge

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
37	2037	SP_VALUE_ RANGE	Range of capsule	–	High and low range limit values, engineering units, and decimal point place for static pressure.
38	2038	CAL_SP_ POINT_HI	25	O/S	The highest calibrated value for static pressure
39	2039	CAL_SP_ POINT_LO	0	O/S	The Lowest calibrated value for static pressure
40	2040	CAL_SP_MIN_ SPAN	1.0	–	The minimum calibration span allowed for static pressure
41	2041	CAL_SP_UNIT	1545 (MPaa)	–	The calibrated engineering unit for static pressure. This unit is linked to XD_SCALE.unit of AI blocks
42	2042	CAL_SP_ DEVIATION_HI	0	O/S	Deviation value for span adjustment of static pressure
43	2043	CAL_SP_ DEVIATION_LO	0	O/S	Deviation value for zero adjustment of static pressure
44	2044	SP_VALUE_FTIME	1	O/S	Damping time constant for static pressure
45	2045	ATM_PRESS	101.325	O/S	Atmosphere pressure value used to obtain gauge pressure value from absolute pressure.
46	2046	CURRENT_ATM_ PRESS_ENABLE	0	O/S	Automatically sets the L-side static pressure value to the atmospheric pressure value (ATM_PRESS).
47	2047	EXT_TEMP_VAL		–	Indicates the external temperature value and status.
48	2048	EXT_TEMP_ RANGE	-200- 850°C	–	Indicates the external temperature sensor range, unit and decimal point.
49	2049	CAL_EXT_TEMP_ POINT_HI	100	O/S	This is High-side adjustment value. Adjust this value so that the current external temperature becomes this setting value.
50	2050	CAL_EXT_TEMP_ POINT_LO	0	O/S	This is Low-side adjustment value. Adjust this value so that the current external temperature becomes this setting value.
51	2051	CAL_EXT_TEMP_ MIN_SPAN	10.0	–	Indicates the minimum span of the external temperature.
52	2052	CAL_EXT_TEMP_ UNIT	1001	–	Indicates the calibration unit of the external temperature sensor.
53	2053	CAL_EXT_TEMP_ DEVIATION_HI	0	O/S	This is the adjustment coefficient for performing span adjustment of the external temperature.
54	2054	CAL_EXT_TEMP_ DEVIATION_LO	0	O/S	This is the adjustment coefficient for performing zero adjustment of the external temperature.
55	2055	EXT_TEMP_ VALUE_FTIME	1.0	O/S	Sets the primary filter time constant (unit: seconds) of the external temperature.
56	2056	EXT_TEMP_ OPTS	0	O/S	Selects the external temperature selection operation. 0=No Selection OFF (output of external temperature) 1=Yes Selection ON (output of FIXED_EXT_TEMP_VALUE) 2=Fall Back Selection at broken wire (output of FIXED_EXT_TEMP_VALUE at broken wire)
57	2057	FIXED_EXT_ TEMP_VALUE	20.0	O/S	Sets the external temperature fixed value.
58	2058	SIMULATE_ MODE	0	AUTO	This is the switch for enabling simulation. 0=Simulation OFF 1=Differential pressure signal simulation ON 2=Static pressure signal simulation ON 3=Differential pressure signal + static pressure signal simulation ON 4=External temperature signal simulation ON 5=Differential pressure signal + external temperature signal simulation ON 6=Static pressure signal + external temperature signal simulation ON 7=Differential pressure signal + static pressure signal + external temperature signal simulation ON 15=Differential pressure signal + static pressure signal + external temperature signal (without damping processing) simulation ON

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
59	2059	SIMULATE_ DPRESS	0	AUTO	Sets the differential pressure value and status for simulation.
60	2060	SIMULATE_ SPRESS	0	AUTO	Sets the static pressure value and status for simulation.
61	2061	SIMULATE_ ETEMP	0	AUTO	Sets the external temperature value and status for simulation.
62	2062	EXT_TEMP_ SENSOR_SN	space	AUTO	This parameter is for recording the serial No. of the external temperature sensor.
63	2063	CLEAR_CAL	0	O/S	Reset zero and span adjustment to factory calibrated values for pressure, static pressure, external temperature and or all.
64	2064	CAP_TEMP_VAL		–	Measured capsule temperature value and status.
65	2065	CAP_TEMP_ RANGE	−40.0 to 120.0°C	–	High and low range limit values, engineering units, decimal point place for capsule temperature.
66	2066	AMP_TEMP_VAL		–	Measured Amplifier temperature value and status.
67	2067	AMP_TEMP_ RANGE	−50.0 to 95.0°C	–	High and low range limit values, engineering units, decimal point place for Amplifier temperature.
68	2068	MODEL	Model code	–	The model code.
69	2069	SPECIAL_ ORDER_ID	Special order number	–	Identification number of special order.
70	2070	MANUFAC_DATE	0	O/S	Date of production
71	2071	CAP_GASKET_MTL	Depend on Specify	O/S	Material of capsule gasket
72	2072	FLANGE_MTL	Depend on Specify	O/S	Material of flange
73	2073	D_VENT_PLUG	Depend on Specify	O/S	Material of drain or vent plug
74	2074	FLANGE_TYPE	Depend on Specify	O/S	Flange type
75	2075	REM_SEAL_ ISOL_MTL	Depend on Specify	O/S	Material of isolating diaphragms for remote seal
76	2076	FLANGE_SIZE	Depend on Specify	O/S	Flange size
77	2077	REM_SEAL_ NUM	Depend on Specify	O/S	Number of remote seal
78	2078	REM_SEAL_ FILL_FLUID	Depend on Specify	O/S	Types of fill fluid in remote seals.
79	2079	REM_SEAL_ TYPE	Depend on Specify	O/S	Types of remote seals
80	2080	ALARM_SUM	Alarm Enable	–	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
81	2081	AUTO_RECOVERY	1 (ON)	O/S	Permission of auto recovery from sensor errors
82	2082	MS_CODE	Null	–	Model suffix and codes
83	2083	DIAG_MODE	0 (stop)	AUTO	Used for ILBD. Refer to A8.2.12
84	2084	DIAG_PERIOD	180	AUTO	Used for ILBD. Refer to A8.2.12
85	2085	DIAG_PRI	1	AUTO	Used for ILBD and Heat Trace Monitoring. Refer to A8.2.12
86	2086	DIAG_ERR		–	Used for ILBD and Heat Trace Monitoring. Refer to A8.2.12
87	2087	DIAG_H_ALM		–	Used for ILBD and Heat Trace Monitoring. Refer to A8.2.12
88	2088	DIAG_L_ALM		–	Used for ILBD and Heat Trace Monitoring. Refer to A8.2.12
89	2089	DIAG_OPTION	0	AUTO	Used for ILBD and Heat Trace Monitoring. Refer to A8.2.12

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
90	2090	REF_LIM_ FDPMIN	7.00E-10	AUTO	Used for ILBD. Refer to A8.2.12
91	2091	REF_LIM_ FSPMIN	1.00E-10	AUTO	Used for ILBD. Refer to A8.2.12
92	2092	REF_LIM_ BLKFMAX	0.5	AUTO	Used for ILBD. Refer to A8.2.12
93	2093	COMP_FLAG	0 (Compensation)	AUTO	Used for ILBD. Refer to A8.2.12
94	2094	DIAG_LIM	(Note)	AUTO	Used for ILBD. Refer to A8.2.12
95	2095	DIAG_COUNT	3	AUTO	Used for ILBD. Refer to A8.2.12
96	2096	REFERENCE_TIME	0x00000000	AUTO	Used for ILBD. Refer to A8.2.12.
97	2097	REFERENCE_FDP	0x00,0	AUTO	Used for ILBD. Refer to A8.2.12.
98	2098	REFERENCE_FSPL	0x00,0	AUTO	Used for ILBD. Refer to A8.2.12.
99	2099	REFERENCE_FSPH	0x00	AUTO	Used for ILBD. Refer to A8.2.12.
100	2100	REFERENCE_BLKF	0x00	AUTO	Used for ILBD. Refer to A8.2.12.
101	2101	REFERENCE_ DPAVG	0x00	AUTO	Used for ILBD. Refer to A8.2.12.
102	2102	VALUE_TIME		–	Used for ILBD. Refer to A8.2.12.
103	2103	VALUE_ FDP		–	Used for ILBD. Refer to A8.2.12.
104	2104	VALUE_ FSPL		–	Used for ILBD. Refer to A8.2.12.
105	2105	VALUE_ FSPH		–	Used for ILBD. Refer to A8.2.12.
106	2106	VALUE_ BLKF		–	Used for ILBD. Refer to A8.2.12.
107	2107	VALUE_DPAVG		–	Used for ILBD. Refer to A8.2.12.
108	2108	RATIO_FDP		–	Used for ILBD. Refer to A8.2.12.
109	2109	RATIO_FSPL		–	Used for ILBD. Refer to A8.2.12.
110	2110	RATIO_FSPH		–	Used for ILBD. Refer to A8.2.12.
111	2111	CRATIO_FDP		–	Used for ILBD. Refer to A8.2.12.
112	2112	NRATIO_FDP		–	Used for ILBD. Refer to A8.2.12.
113	2113	DIAG_APPLICABLE	0	–	Used for ILBD. Refer to A8.2.12.
114	2114	FLG_TEMP_VAL		–	Used for Heat Trace monitoring. Refer to A8.2.12.
115	2115	FLG_TEMP_RANGE	-50.0 to 130.0°C	–	Used for Heat Trace monitoring. Refer to A8.2.12.
116	2116	FLG_TEMP_COEFF	0	AUTO	Used for Heat Trace monitoring. Refer to A8.2.12.
117	2117	FLG_TEMP_PRI	1	AUTO	Used for Heat Trace monitoring. Refer to A8.2.12.
118	2118	FLG_TEMP_H_LIM	130	AUTO	Used for Heat Trace monitoring. Refer to A8.2.12.
119	2119	FLG_TEMP_L_LIM	-50	AUTO	Used for Heat Trace monitoring. Refer to A8.2.12.
120	2120	FLG_TEMP_ALM		–	Used for Heat Trace monitoring. Refer to A8.2.12.
121	2121	TET_KEY1		–	Not used for EJX multivariable transmitter
122	2122	TET_KEY2		–	Not used for EJX multivariable transmitter
123	2123	TET_KEY3		–	Not used for EJX multivariable transmitter
124 to 139	2124 to 2139	TEST1 to 16		–	Not used for EJX multivariable transmitter

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Note: Refer to A8.2.1

9.3 FLOW Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2300	Block Header	TAG: “FTB”	Block Tag =O/S	Information, such as Block Tag, DD Revision and Execution Time, relating to this block
1	2301	ST_REV	–	–	This parameter expresses the revision level of the transducer block setting parameters. This revision is updated when the setting value is changed. This parameter is used, for example, to investigate if parameters have been changed.
2	2302	TAG_DESC		AUTO	Universal parameter for storing comments to describe the content of tags
3	2303	STRATEGY	1	AUTO	Universal parameter intended for use when the host system separates the function blocks
4	2304	ALERT_KEY	1	AUTO	This is one of the universal parameters and is key information for identifying where an alert has occurred. Normally, the host system identifies specific area in a plant covered by a specific operator, and this information is used for selecting only the required alert.
5	2305	MODE_BLK	AUTO	AUTO	This universal parameter expresses the operation mode of the block, and comprises the Actual mode, Target mode, Permit mode, and Normal mode.
6	2306	BLOCK_ERR	0x0000	–	Indicates the error state relating to the self block.
7	2307	UPDATE_EVT	–	–	Indicates the content of an event when an update event has occurred.
8	2308	BLOCK_ALM	–	–	Indicates the content of an error that has occurred in the block.
9	2309	TRANSDUCER _DIRECTORY	–	–	This parameter is for storing the index of the transducer to be included in the transmitter.
10	2310	TRANSDUCER _TYPE	104 (Standard Flow with Calibration)	–	Indicates the type of transmitter.
11	2311	XD_ERROR	–	–	Stores the most important error among the errors currently occurring in the transducer block. When “0” is stored, this means that no errors are occurring.
12	2312	COLLECTION _DIRECTORY	–	–	Stores the index of important parameters in the transducer block and the item ID of the corresponding DD.
13	2313	FLOW_VALUE _TYPE	1	–	Indicates the type of flow. 1: Mass flow 2: Volume flow 3: Standard volume flow
14	2314	FLOW_VALUE	–	–	Indicates the flow value and its status.
15	2315	FLOW_VALUE_UNIT	1324: kg/h	–	Indicates the unit of the flow value.
16	2316	FLOW_VALUE _DECIMAL	0	–	Indicates the number of digits past the decimal point of the flow value.
17	2317	FLOW_VALUE _FTIME	0	O/S	Indicates the primary filter time constant (unit: seconds) of the flow value.
18	2318	DIFF_ PRESSURE	–	–	Indicates the differential pressure value used in the flow calculation and its status.
19	2319	DIFF_PRESSURE_UNIT	1133(kPa)	O/S	Sets the unit of the differential pressure value.
20	2320	STATIC_ PRESSURE	–	–	Indicates the static pressure value used in the flow calculation and its status.
21	2321	STATIC_ PRESSURE_UNIT	1545(MPaa)	O/S	Sets the unit of the static pressure value.
22	2322	EXT_ TEMPERATURE	–	–	Indicates the external temperature value used in the flow calculation and its status.
23	2323	EXT_ TEMPERAURE_UNIT	1001(°C)	O/S	Sets the unit of the external temperature value.
24	2324	FLOW_ CALCULATION_ MODE	0	O/S	Switches the flow calculation mode. 0: Auto Compensation Mode 1: Basic Mode

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
25	2325	FIXED_FLOW_ VALUE	0	O/S	Sets the flow calculation coefficient (Kfactor) used in the Basic Mode.
26	2326	REF_STATIC_ PRESSURE	0.101325	O/S	Sets the design reference static pressure value used in the Basic Mode.
27	2327	REF_EXT_ TEMPERATURE	0	O/S	Sets the design reference temperature value used in the Basic Mode.
28	2328	TEMP_K1_ FOR_LIQUID	0	O/S	Sets the temperature coefficient for density compensation used when calculating the liquid flow in the Basic Mode.
29	2329	FLUID_TYPE_ CODE	2	O/S	Sets the fluid code in the Basic Mode. 1: Liquid 2: Gas
30	2330	ALARM_SUM	Alarm / Enable	–	Indicates the alarm state of the entire block.
31	2331	DENSITY_ UNIT_CODE*1	1097(kg/m3)	O/S	Indicates the density unit. 1097: kg/m3 1107: lb/ft3
32	2332	LENGTH_ UNIT_CODE*1	1010(m)	O/S	Indicates the length unit. 1018: ft 1010: m 1019: in 1012: cm 1013: mm
33	2333	PRIMARY_ DEVICE_CODE*1	2	O/S	Indicates the diaphragm type code. For details on type code, see Table 9.1.
34	2334	PRIMARY_ DEVICE_DIAMETER*1	0.03162	O/S	Indicates the diaphragm inner diameter.
35	2335	PRIMARY_DEVICE_ EXPANSION_COEF*1	0.00001681	O/S	Indicates the diaphragm linear expansion coefficient value.
36	2336	PRIMARY_DEVICE_ REF_TEMPERATURE*1	20	O/S	Indicates the temperature during diaphragm inner diameter measurement.
37	2337	PIPE_DIAMETER*1	0.0527	O/S	Indicates the pipe inner diameter.
38	2338	PIPE_ EXPANSION_COEF*1	0.00001148	O/S	Indicates the pipe linear expansion coefficient value.
39	2339	PIPE_REF_ TEMPERATURE*1	20	O/S	Indicates the temperature during pipe inner diameter measurement.
40	2340	BASE_DENSITY_ FOR_VOLUME_FLOW*1	1.250380253	O/S	Indicates the density for conversion of the volume flow unit.
41	2341	FLOW_CONFIG1*1	–	O/S	Indicates the compensation coefficient of the flow coefficient.
42	2342	FLOW_CONFIG2*1	–	O/S	Indicates the compensation coefficient of the expansion compensation coefficient.
43	2343	FLOW_CONFIG3*1	–	O/S	Indicates the precision compensation coefficient.
44	2344	FLOW_CONFIG4*1	–	O/S	Indicates the viscosity compensation coefficient.
45	2345	CORRECTION_VALUE*1	–	–	Indicates the flow compensation value.
46	2346	CONFIG_SOFT_REV*1		O/S	Space Used as a record of the setup tool software version.
47	2347	CONFIG_DATE*1		O/S	Space Used as a record of the setting date.
48	2348	CONFIG_WHO*1		O/S	Space Used as a record of the setter.
49	2349	CONFIG_STATUS*1		O/S	Space Used as a memo.
50	2350	CONFIG_VSTRING32*1		O/S	Space Used as a memo.
51	2351	CONFIG_VSTRING16*1		O/S	Space Used as a memo.
52	2352	CONFIG_OSTRING32*1		O/S	Space Used as a memo.
53	2353	CONFIG_OSTRING2*1		O/S	Sum value of precision flow setting data.

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*1: These are the parameters which are allowed to be written only by EJXMVTool. Changes using other parameter setting tools or handheld terminals may cause Check Sum Error (AL83).

⚠ CAUTION

Indexes 2331 to 2353 are parameters for precision volume calculation, and data calculated by the MV setup tool must be written to these parameters. For this reason, these parameters must not be written with data other than that from the MV setup tool.
When parameters marked by the “*1” symbol are written individually, a sum value error and an alarm occurs.

Table 9.1 Primary Device Codes

Code	Primary Device
1	Fixed Mode
2	Orifice Corner Taps [ISO5167-1 1991]
3	Orifice Corner Taps [ISO5167-2 2003]
4	Orifice Corner Taps [ASME MFC-3M 1989]
5	Orifice Flange Taps [ISO5167-1 1991]
6	Orifice Flange Taps [ISO5167-2 2003]
7	Orifice Flange Taps [ASME MFC-3M 1989]
8	Orifice Flange Taps [AGA No.3 1992]
9	Orifice D and D/2 Taps [ISO5167-1 1991]
10	Orifice D and D/2 [ISO5167-2 2003]
11	Orifice D and D/2 [ASME MFC-3M 1989]
12	ISA1932 nozzle [ISO5167-1 1991/ ISO5167-3 2003]
13	Long radius nozzle [ISO5167-1 1991/ ISO5167-3 2003]
14	ASME FLOW NOZZLES [ASME MFC-3M 1989]
15	Venturi nozzle [ISO5167-1 1991/ ISO5167-3 2003]
16	Classical Venturi tube “as cast” convergent section [ISO5167-1 1991/ ISO5167-4 2003]
17	ASME Venturi Tubes With a rough Cast or Fabricated Convergent [ASME MFC-3M 1989]
18	Classical Venturi tube with a machined convergent section [ISO5167-1 1991/ ISO5167-4 2003]
19	ASME Venturi Tubes With a machined convergent section [ASME MFC-3M 1989]
20	Classical Venturi tube with a rough-welded sheet-iron convergent section [ISO5167-1 1991/ ISO5167-4 2003]

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9.4 LCD Transducer Block

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
0	2500	Block Header	TAG: “LTB”	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	2501	ST_REV	–	–	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
2	2502	TAG_DESC	Null	O/S	The user description of the intended application of the block
3	2503	STRATEGY	1	O/S	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	2504	ALERT_KEY	1	O/S	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	2505	MODE_BLK	AUTO	O/S	The actual, target, permitted, and normal modes of the block.
6	2506	BLOCK_ERR	–	–	This parameter reflects the error status associated with hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	2507	UPDATE_EVT	–	–	This alert is generated by any change to the static data.
8	2508	BLOCK_ALM	–	–	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute.
9	2509	TRANSDUCER_ DIRECTORY	–	–	A directory that specifies the number and starting indices of the transducers.
10	2510	TRANSDUCER_ TYPE	65535 (other)	–	Identifies transducer.
11	2511	XD_ERROR	–	–	The error code in transducer. 0=No failure 19=Configuration error
12	2512	COLLECTION_ DIRECTORY	–	–	A directory that specifies the number, starting indices, and DD Item Ids of the data collections in each transducer within a transducer block.
13	2513	DISPLAY_SEL	DISPLAY1 ON	O/S	Selection of display1 to 4 to be shown on LCD Bit0=1:DISPLAY1 ON Bit1=1:DISPLAY2 ON Bit2=1:DISPLAY3 ON Bit3=1:DISPLAY4 ON
14	2514	INFO_SEL	UNIT ON	O/S	Selection of items to be displayed Bit0=1:TAG ON Bit1=1:PARAMETER ON Bit2=1:UNIT ON Bit3=1:STATUS ON
15	2515	BLOCK_TAG1	Multisensing type: AI1 Flow Measurement type: AI4	–	Block tag which includes a parameter to be displayed on display1
16	2516	PARAMETER_ SEL1	Multisensing type: AI1 OUT Flow Measurement type: AI4 OUT	O/S	Selection of a parameter to be displayed on display1. Select a parameter from Table 6.1
17	2517	DISPLAY_TAG1	Null	O/S	Name of block tag to be displayed on display1; up to six alphanumeric plus a slash [/] and a period [.]
18	2518	UNIT_SEL1	0 (Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL1 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT1 will be displayed when "Custom" is selected.
19	2519	DISPLAY_UNIT1	Null	O/S	User specified unit to be displayed on display1, which will be available when "Custom" is selected at UNIT SEL1.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
20	2520	EXP_MODE1	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
21	2521	BLOCK_TAG2	2014 (PRIMARY_ VALUE)	–	Block tag which includes a parameter to be displayed on display2
22	2522	PARAMETER_ SEL2	0 (PRIMARY_ VALUE)	O/S	Selection of a parameter to be displayed on display2. Select a parameter from Table 6.1
23	2523	DISPLAY_TAG2	Null	O/S	Name of block tag to be displayed on display2; up to six alphanumeric plus a slash [/] and a period [.]
24	2524	UNIT_SEL2	0 (Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL2 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT2 will be displayed when "Custom" is selected.
25	2525	DISPLAY_UNIT2	Null	O/S	User specified unit to be displayed on display2, which will be available when "Custom" is selected at UNIT SEL2.
26	2526	EXP_MODE2	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
27	2527	BLOCK_TAG3	2029 (SECONDARY_ VALUE)	–	Block tag which includes a parameter to be displayed on display3
28	2528	PARAMETER_ SEL3	1 (SECONDARY_ VALUE)	O/S	Selection of a parameter to be displayed on display3. Select a parameter from Table 6.1
29	2529	DISPLAY_TAG3	Null	O/S	Name of block tag to be displayed on display3; up to six alphanumeric plus a slash [/] and a period [.]
30	2530	UNIT_SEL3	0 (Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL3 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT3 will be displayed when "Custom" is selected.
31	2531	DISPLAY_UNIT3	Null	O/S	User specified unit to be displayed on display3, which will be available when "Custom" is selected at UNIT SEL3.
32	2532	EXP_MODE3	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
33	2533	BLOCK_TAG4	2047 (CAP_ TEMP_VAL)	–	Block tag which includes a parameter to be displayed on display4
34	2034	PARAMETER_ SEL4	3 (CAP_TEMP_ VAL)	O/S	Selection of a parameter to be displayed on display4. Select a parameter from Table 6.1
35	2535	DISPLAY_TAG4	Null	O/S	Name of block tag to be displayed on display4; up to six alphanumeric plus a slash [/] and a period [.]
36	2536	UNIT_SEL4	0 (Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL4 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT4 will be displayed when "Custom" is selected.
37	2537	DISPLAY_UNIT4	Null	O/S	User specified unit to be displayed on display4, which will be available when "Custom" is selected at UNIT SEL4.
38	2038	EXP_MODE4	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
39	2039	BAR_GRAPH_ SELECT	1 (display)	O/S	Selection of bar graph indicator
40	2540	DISPLAY_CYCLE	3 (2.4sec)	O/S	Duration of display cycle. (Time unit: 1=800msec)
41	2541	TEST40	0	–	Not used for EJX
42	2542	BLOCK_TAG5	Null	–	Block tag which includes a parameter to be displayed on display5
43	2543	PARAMETER_ SEL5	4008	O/S	Selection of a parameter to be displayed on display5. Select a parameter from Table 6.1
44	2544	DISPLAY_TAG5	Null	O/S	Name of block tag to be displayed on display5; up to six alphanumeric plus a slash [/] and a period [.]

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
45	2545	UNIT_SEL5	0(Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL5 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT5 will be displayed when "Custom" is selected.
46	2546	DISPLAY_UNIT5	Null	O/S	User specified unit to be displayed on display5, which will be available when "Custom" is selected at UNIT SEL5.
47	2547	EXP_MODE5	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
48	2548	BLOCK_TAG6	Null	_	Block tag which includes a parameter to be displayed on display6
49	2549	PARAMETER_ SEL6	4108	O/S	Selection of a parameter to be displayed on display6. Select a parameter from Table 6.1
50	2550	DISPLAY_TAG6	Null	O/S	Name of block tag to be displayed on display6; up to six alphanumeric plus a slash [/] and a period [.]
51	2551	UNIT_SEL6	0(Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL6 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT6 will be displayed when "Custom" is selected.
52	2552	DISPLAY_UNIT6	Null	O/S	User specified unit to be displayed on display6, which will be available when "Custom" is selected at UNIT SEL6.
53	2553	EXP_MODE6	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
54	2554	BLOCK_TAG7	Null	_	Block tag which includes a parameter to be displayed on display7
55	2555	PARAMETER_ SEL7	4208	O/S	Selection of a parameter to be displayed on display7. Select a parameter from Table 6.1
56	2556	DISPLAY_TAG7	Null	O/S	Name of block tag to be displayed on display7; up to six alphanumeric plus a slash [/] and a period [.]
57	2557	UNIT_SEL7	0(Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL7 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT7 will be displayed when "Custom" is selected.
58	2558	DISPLAY_UNIT7	Null	O/S	User specified unit to be displayed on display7, which will be available when "Custom" is selected at UNIT SEL7.
59	2559	EXP_MODE7	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
60	2560	BLOCK_TAG8	Null	_	Block tag which includes a parameter to be displayed on display8
61	2561	PARAMETER_ SEL8	2035	O/S	Selection of a parameter to be displayed on display8. Select a parameter from Table 6.1
62	2562	DISPLAY_TAG8	Null	O/S	Name of block tag to be displayed on display8; up to six alphanumeric plus a slash [/] and a period [.]
63	2563	UNIT_SEL8	0(Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL8 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT8 will be displayed when "Custom" is selected.
64	2564	DISPLAY_UNIT8	Null	O/S	User specified unit to be displayed on display8, which will be available when "Custom" is selected at UNIT SEL8.
65	2565	EXP_MODE8	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
66	2566	BLOCK_TAG9	Null	_	Block tag which includes a parameter to be displayed on display9
67	2567	PARAMETER_ SEL9	2064	O/S	Selection of a parameter to be displayed on display9. Select a parameter from Table 6.1
68	2568	DISPLAY_TAG9	Null	O/S	Name of block tag to be displayed on display9; up to six alphanumeric plus a slash [/] and a period [.]

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
69	2569	UNIT_SEL9	0(Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL9 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT9 will be displayed when "Custom" is selected.
70	2570	DISPLAY_UNIT9	Null	O/S	User specified unit to be displayed on display9, which will be available when "Custom" is selected at UNIT SEL9.
71	2571	EXP_MODE9	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.
72	2572	BLOCK_TAG10	Null	–	Block tag which includes a parameter to be displayed on display10
73	2573	PARAMETER_ SEL10	2314	O/S	Selection of a parameter to be displayed on display10. Select a parameter from Table 6.1
74	2574	DISPLAY_TAG10	Null	O/S	Name of block tag to be displayed on display10; up to six alphanumeric plus a slash [/] and a period [.]
75	2575	UNIT_SEL10	0(Auto)	O/S	Selection of unit to be displayed. The unit of the parameter which is selected at PARAMETER SEL10 will be displayed when "Auto" is selected; user-specified unit at DISPLAY UNIT10 will be displayed when "Custom" is selected.
76	2576	DISPLAY_UNIT10	Null	O/S	User specified unit to be displayed on display10, which will be available when "Custom" is selected at UNIT SEL10.
77	2577	EXP_MODE10	0	O/S	Selection of the displayed value in exponent such as x1, x10, x100, and x1000.

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9.5 AI Function Block

Relative Index	Index AI1	Index AI2	Index AI3	Index AI4	Index AI5	Parameter Name	Factory Default	Write Mode	Explanation
0	4000	4100	4200	4300	4400	Block Header	TAG: "AI1" or "AI2" or "AI3" or "AI4" or "AI5"	Block Tag = O/S	Information on this block such as Block Tag, DD Revision, Execution Time etc.
1	4001	4101	4201	4301	4401	ST_REV	–	–	The revision level of the static data associated with the function block. The revision value will be incremented each time a static parameter value in the block is changed.
2	4002	4102	4202	4302	4402	TAG_ DESC	Null	AUTO	The user description of the intended application of the block.
3	4003	4103	4203	4303	4403	STRATEGY	1	AUTO	The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block.
4	4004	4104	4204	4304	4404	ALERT_ KEY	1	AUTO	The identification number of the plant unit. This information may be used in the host for sorting alarms, etc.
5	4005	4105	4205	4305	4405	MODE_ BLK	AUTO	AUTO	The actual, target, permitted, and normal modes of the block.
6	4006	4106	4206	4306	4406	BLOCK_ ERR	–	–	This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown.
7	4007	4107	4207	4307	4407	PV	–	–	Either the primary analog value for use in executing the function, or a process value associated with it. May also be calculated from the READBACK value of an AO block.
8	4008	4108	4208	4308	4408	OUT	–	Value = MAN	The primary analog value calculated as a result of executing the function.
9	4009	4109	4209	4309	4409	SIMULATE	Disable	AUTO	Allows the transducer analog input or output to the block to be manually supplied when simulate is enabled. When simulation is disabled, the simulate value and status track the actual value and status.
10	4010	4110	4210	4310	4410	XD_ SCALE	AI1, AI2, AI3: Specified at the time of order AI4: 0 to 1000 kg/h	O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel.
11	4011	4111	4211	4311	4411	OUT_ SCALE	AI1, AI2, AI3: Specified at the time of order AI4: 0 to 1000 kg/h	O/S	The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter and parameters which have the same scaling as OUT.
12	4012	4112	4212	4312	4412	GRANT_ DENY	0	AUTO	Options for controlling access of host computers and local control panels to operating, tuning and alarm parameters of the block.
13	4013	4113	4213	4313	4413	IO_OPTS	0	O/S	Options which the user may select to alter input and output block processing
14	4014	4114	4214	4314	4414	STATUS_ OPTS	0	O/S	Options which the user may select in the block processing of status
15	4015	4115	4215	4315	4415	CHANNEL	AI1: 1 AI2: 2 AI3: 4 AI4: 5 AI5: 6	O/S	The number of the logical hardware channel that is connected to this I/O block. This information defines the transducer to be used going to or from the physical world. 1:PV 2:SV 3:TV 4:EXT_TEMP_VALUE 5:FLOW_VALUE 6:CAP_TEMP_VAL 7:AMP_TEMP_VAL 8:FLG_TEMP_VAL

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Relative Index	Index AI1	Index AI2	Index AI3	Index AI4	Index AI5	Parameter Name	Factory Default	Write Mode	Explanation
16	4016	4116	4216	4316	4416	L_TYPE	AI1: Specified at the time of order AI2 to AI5: Direct	MAN	Determines if the values passed by the transducer block to the AI block may be used directly (Direct) or if the value is in different units and must be converted linearly (Indirect), or with square root (Ind Sqr Root), using the input range defined by the transducer and the associated output range.
17	4017	4117	4217	4317	4417	LOW_ CUT	Linear: 0% Square root: 10%	AUTO	Limit used in square root processing. A value of zero percent of scale is used in block processing if the transducer value falls below this limit. This feature may be used to eliminate noise near zero for a flow sensor. The setting is in an engineering unit of OUT_SCALE.
18	4018	4118	4218	4318	4418	PV_ FTIME	0sec	AUTO	Time constant of a single exponential filter for the PV, in seconds.
19	4019	4119	4219	4319	4419	FIELD_ VAL	–	–	Raw value of the field device in percent of thePV range, with a status reflecting the Transducer condition, before signal characterization (L_TYPE) or filtering (PV_FTIME).
20	4020	4120	4220	4320	4420	UPDATE_EVT	–	–	This alert is generated by any change to the static data.
21	4021	4121	4221	4321	4421	BLOCK_ ALM	–	–	The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.
22	4022	4122	4222	4322	4422	ALARM_ SUM	Enable	–	The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.
23	4023	4123	4223	4323	4423	ACK_ OPTION	0xFFFF	AUTO	Selection of whether alarms associated with the block will be automatically acknowledged.
24	4024	4124	4224	4324	4424	ALARM_ HYS	0.5%	AUTO	Amount the PV must return within the alarm limits before the alarm condition clears. Alarm Hysteresis is expressed as a percent of the PV span.
25	4025	4125	4225	4325	4425	HI_HI_PRI	0	AUTO	Priority of the high high alarm.
26	4026	4126	4226	4326	4426	HI_HI_LIM	+INF	AUTO	The setting for high high alarm in engineering units.
27	4027	4127	4227	4327	4427	HI_PRI	0	AUTO	Priority of the high alarm.
28	4028	4128	4228	4328	4428	HI_LIM	+INF	AUTO	The setting for high alarm in engineering units.
29	4029	4129	4229	4329	4429	LO_PRI	0	AUTO	Priority of the low alarm.
30	4030	4130	4230	4330	4430	LO_LIM	–INF	AUTO	The setting for the low alarm in engineering units.
31	4031	4131	4231	4331	4431	LO_LO_PRI	0	AUTO	Priority of the low low alarm.
32	4032	4132	4232	4332	4432	LO_LO_LIM	–INF	AUTO	The setting of the low low alarm in engineering units.
33	4033	4133	4233	4333	4433	HI_HI_ALM	–	–	The status for high high alarm and its associated time stamp.
34	4034	4134	4234	4334	4434	HI_ALM	–	–	The status for high alarm and its associated time stamp.
35	4035	4135	4235	4335	4435	LO_ALM	–	–	The status of the low alarm and its associated time stamp.
36	4036	4136	4236	4336	4436	LO_LO_ ALM	–	–	The status of the low low alarm and its associated time stamp.
37	4037	4137	4237	4337	4437	OUT_D_ SEL	0	–	Selection of alarm to output it from OUT_D
38	4038	4138	4238	4338	4438	OUT_D	–	Value= MAN	A discrete value and status that shows HI_HI, HI, LO_LO, LO state.

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9.6 Parameter Names Cross Reference

Parameter's name may appear differently according to the tool you use. If you cannot find the designated parameters in the parameters list in the former sections, please use the following cross lists.

Sensor Transducer Block

Relative Index	Parameter Name	Label
0	BLOCK_HEADER	Characteristics
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory Entry
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	PRIMARY_VALUE_TYPE	Pressure Type
14	PRIMARY_VALUE	Pressure
15	PRIMARY_VALUE_RANGE	Pressure Range
16	CAL_POINT_HI	Calibration Highest Point
17	CAL_POINT_LO	Calibration Lowest Point
18	CAL_MIN_SPAN	Calibration Minimum Span
19	CAL_UNIT	Calibration Units
20	SENSOR_TYPE	Sensor Type
21	SENSOR_RANGE	Sensor Range
22	SENSOR_SN	Sensor Serial Number
23	SENSOR_CAL_METHOD	Sensor Calibration method
24	SENSOR_CAL_LOC	Sensor Calibration Location
25	SENSOR_CAL_DATE	Sensor Calibration Date
26	SENSOR_CAL_WHO	Sensor Calibration Who
27	SENSOR_ISOLATOR_MTL	Sensor Isolator Metal
28	SENSOR_FILL_FLUID	Sensor Fill Fluid
29	SECONDARY_VALUE	Static Pres High Connector
30	SECONDARY_VALUE_UNIT	Static Pres Unit
31	CAL_DEVIATION_HI	Calibration Highest Deviation
32	CAL_DEVIATION_LO	Calibration Lowest Deviation
33	EXTERNAL_ZERO_TRIM	External Zero Trim
34	PRIMARY_VALUE_FTIME	Pressure Filter Time
35	TERTIARY_VALUE	Static Pres Low Connector
36	SP_VALUE_TYPE	Static Pres Type
37	SP_VALUE_RANGE	Static Pres Range
38	CAL_SP_POINT_HI	Static Pres Calibration Highest Point
39	CAL_SP_POINT_LO	Static Pres Calibration Lowest Point
40	CAL_SP_MIN_SPAN	Static Pres Calibration Minimum Span
41	CAL_SP_UNIT	Static Pres Calibration Units
42	CAL_SP_DEVIATION_HI	Static Pres Calibration Highest Deviation
43	CAL_SP_DEVIATION_LO	Static Pres Calibration Lowest Deviation
44	SP_VALUE_FTIME	Static Pres Filter Time
45	ATM_PRESS	Atmosphere Pressure
46	CURRENT_ATM_ PRESS_ENABLE	One Push Atm Pressure Enabled
47	EXT_TEMP_VAL	Ext Temp
48	EXT_TEMP_RANGE	Ext Temp Range
49	CAL_EXT_TEMP_POINT_HI	Ext Temp Calibration Highest Point
50	CAL_EXT_TEMP_POINT_LO	Ext Temp Calibration Lowest Point
51	CAL_EXT_TEMP_MIN_SPAN	Ext Temp Calibration Minimum Span
52	CAL_EXT_TEMP_UNIT	Ext Temp Calibration Units
53	CAL_EXT_TEMP_DEVIATION_HI	Ext Temp Calibration Highest Deviation
54	CAL_EXT_TEMP_DEVIATION_LO	Ext Temp Calibration Lowest Deviation
55	EXT_TEMP_VALUE_FTIME	Ext Temp Filter Time
56	EXT_TEMP_OPTS	Fixed Mode
57	FIXED_EXT_TEMP_VALUE	Ext Temp at Fixed Mode
58	SIMULATE_MODE	Simulation Mode
59	SIMULATE_DPRESS	Simulation Pres
60	SIMULATE_SPRESS	Simulation Static Pres
61	SIMULATE_ETEMP	Simulation Ext Temp
62	EXT_TEMP_SENSOR_SN	Ext Temp Sensor Serial Number
63	CLEAR_CAL	Clear Calibration
64	CAP_TEMP_VAL	Cap Temp
65	CAP_TEMP_RANGE	Cap Temp Range
66	AMP_TEMP_VAL	Amp Temp
67	AMP_TEMP_RANGE	Amp Temp range
68	MODEL	Model
69	SPECIAL_ORDER_ID	Special Order ID
70	MANUFAC_DATE	Manufacture Date
71	CAP_GASKET_MTL	Capsule Gasket Material
72	FLANGE_MTL	Flange Material
73	D_VENT_PLUG	Drain Vent Plug
74	FLANGE_TYPE	Flange Type
75	REM_SEAL_ISOL_MTL	Remote Seal Isolator Material
76	FLANGE_SIZE	Flange Size
77	REM_SEAL_NUM	Remote Seal Number
78	REM_SEAL_FILL_FLUID	Remote Seal Fill Fluid
79	REM_SEAL_TYPE	Remote Seal Type
80	ALARM_SUM	Alarm Summary
81	AUTO_RECOVERY	Auto Recovery
82	MS_CODE	Model Suffix Code
83	DIAG_MODE	Diag Mode
84	DIAG_PERIOD	Diag Period
85	DIAG_PRI	Diag Priority
86	DIAG_ERR	Diag Error
87	DIAG_H_ALM	Diag High Side Alarm
88	DIAG_L_ALM	Diag Low Side Alarm
89	DIAG_OPTION	Diag Option
90	REF_LIM_ FDPMIN	Ref Lim fDPmin
91	REF_LIM_ FSPMIN	Ref Lim fSPmin
92	REF_LIM_ BLKFMAX	Ref Lim BlkFmax
93	COMP_FLAG	Diag Dpcomp
94	DIAG_LIM	Diag Limit
95	DIAG_COUNT	Diag Suppress Count
96	REFERENCE_TIME	Ref Time
97	REFERENCE_FDP	Ref fDP
98	REFERENCE_FSPL	Ref fSPl
99	REFERENCE_FSPH	Ref fSPh
100	REFERENCE_BLKF	Ref BlkF

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Relative Index	Parameter Name	Label
101	REFERENCE_DPAVG	Ref DP Avg
102	VALUE_TIME	Curr Time
103	VALUE_ FDP	Curr fDP
104	VALUE_ FSPL	Curr fSPl
105	VALUE_ FSPH	Curr fSPh
106	VALUE_ BLKF	Curr BlkF
107	VALUE_DPAVG	Curr DP Avg
108	RATIO_FDP	Ratio fDP
109	RATIO_FSPL	Ratio fSPl
110	RATIO_FSPH	Ratio fSPh
111	CRATIO_FDP	Cratio fDP
112	NRATIO_FDP	Nratio fDP
113	DIAG_APPLICABLE	Diag Applicable
114	FLG_TEMP_VAL	Flg Temp
115	FLG_TEMP_RANGE	Flg Temp Range
116	FLG_TEMP_COEF	Flg Temp Coefficient
117	FLG_TEMP_PRI	Flg Temp Diag Priority
118	FLG_TEMP_H_LIM	Flg Temp High Limit
119	FLG_TEMP_L_LIM	Flg Temp Low Limit
120	FLG_TEMP_ALM	Flg Temp Alarm
121	TEST_KEY1	Test Key 1
122	TEST_KEY2	Test Key 2
123	TEST_KEY3	Test Key 3

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Flow Transducer Block

Relative Index	Parameter Name	Label
0	BLOCK_HEADER	Characteristics
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory Entry
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	FLOW_VALUE_TYPE	Flow Type
14	FLOW_VALUE	Flow
15	FLOW_VALUE_UNIT	Flow Unit
16	FLOW_VALUE_DECIMAL	Flow Decimal
17	FLOW_VALUE_FTIME	Flow Filter Time
18	DIFF_PRESSURE	Differential Pressure
19	DIFF_PRESSURE_UNIT	Differential Pressure Unit
20	STATIC_PRESSURE	Static Pressure
21	STATIC_PRESSURE_UNIT	Static Pressure Unit
22	EXT_TEMPERATURE	External Temperature
23	EXT_TEMPERAURE_UNIT	External Temperature Unit
24	FLOW_CALCULATION_MODE	Flow Calculation Mode
25	FIXED_FLOW_VALUE	Fixed Flow Value
26	REF_STATIC_PRESSURE	Reference Static Pressure
27	REF_EXT_TEMPERATURE	Reference External Temperature
28	TEMP_K1_FOR_LIQUID	Temp K1 for Liquid Variable
29	FLUID_TYPE_CODE	Fluid Type Code
30	ALARM_SUM	Alarm Summary
31	DENSITY_UNIT_CODE	Density Unit Code
32	LENGTH_UNIT_CODE	Length Unit Code
33	PRIMARY_DEVICE_CODE	Primary Device Code
34	PRIMARY_DEVICE_DIAMETER	Primary Device Diameter
35	PRIMARY_DEVICE_ EXPANSION_COEF	Primary Device Expansion Coefficient
36	PRIMARY_DEVICE_ EF_TEMPERATURE	Primary Device Refference Temperature
37	PIPE_DIAMETER	Pipe Diameter
38	PIPE_EXPANSION_COEF	Pipe Expansion Coefficient
39	PIPE_REF_TEMPERATURE	Pipe Refference Temperature
40	BASE_DENSITY_FOR_ VOLUME_FLOW	Base Density for Volume Flow
41	FLOW_CONFIG1	Flow Configuration Parameter 1
42	FLOW_CONFIG2	Flow Configuration Parameter 2
43	FLOW_CONFIG3	Flow Configuration Parameter 3
44	FLOW_CONFIG4	Flow Configuration Parameter 4
45	CORRECTION_VALUE	Correction Value
46	CONFIG_SOFT_REV	Configuration Tool Software Revision
47	CONFIG_DATE	Configuration Date
48	CONFIG_WHO	Configurated Person
49	CONFIG_STATUS	Configuration Status
50	CONFIG_VSTRING32	Configuration Memo 1
51	CONFIG_VSTRING16	Configuration Memo 2
52	CONFIG_OSTRING32	Configuration Memo 3
53	CONFIG_OSTRING2	Configuration Memo 4

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LCD Transducer Block

Relative Index	Parameter Name	Label
0	BLOCK_HEADER	Characteristics
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	UPDATE_EVT	Update Event
8	BLOCK_ALM	Block Alarm
9	TRANSDUCER_DIRECTORY	Transducer Directory Entry
10	TRANSDUCER_TYPE	Transducer Type
11	XD_ERROR	Transducer Error
12	COLLECTION_DIRECTORY	Collection Directory
13	DISPLAY_SEL	Display Selection
14	INFO_SEL	Information Selection
15	BLOCK_TAG1	Block Tag 1
16	PARAMETER_SEL1	Parameter Selection 1
17	DISPLAY_TAG1	Display Tag 1
18	UNIT_SEL1	Unit Selection 1
19	DISPLAY_UNIT1	Display Unit 1
20	EXP_MODE1	Exponent Mode 1
21	BLOCK_TAG2	Block Tag 2
22	PARAMETER_SEL2	Parameter Selection 2
23	DISPLAY_TAG2	Display Tag 2
24	UNIT_SEL2	Unit Selection 2
25	DISPLAY_UNIT2	Display Unit 2
26	EXP_MODE2	Exponent Mode 2
27	BLOCK_TAG3	Block Tag 3
28	PARAMETER_SEL3	Parameter Selection 3
29	DISPLAY_TAG3	Display Tag 3
30	UNIT_SEL3	Unit Selection 3
31	DISPLAY_UNIT3	Display Unit 3
32	EXP_MODE3	Exponent Mode 3
33	BLOCK_TAG4	Block Tag 4
34	PARAMETER_SEL4	Parameter Selection 4
35	DISPLAY_TAG4	Display Tag 4
36	UNIT_SEL4	Unit Selection 4
37	DISPLAY_UNIT4	Display Unit 4
38	EXP_MODE4	Exponent Mode 4
39	BAR_GRAPH_SELECT	Bar Graph Selection
40	DISPLAY_CYCLE	Display CycleDisplay Cycle
41	TEST40	LCD_TEST
42	BLOCK_TAG5	Block Tag 5
43	PARAMETER_SEL5	Parameter Selection 5
44	DISPLAY_TAG5	Display Tag 5
45	UNIT_SEL5	Unit Selection 5
46	DISPLAY_UNIT5	Display Unit 5
47	EXP_MODE5	Exponent Mode 5
48	BLOCK_TAG6	Block Tag 6
49	PARAMETER_SEL6	Parameter Selection 6
50	DISPLAY_TAG6	Display Tag 6
51	UNIT_SEL6	Unit Selection 6
52	DISPLAY_UNIT6	Display Unit 6
53	EXP_MODE6	Exponent Mode 6
54	BLOCK_TAG7	Block Tag 7
55	PARAMETER_SEL7	Parameter Selection 7
56	DISPLAY_TAG7	Display Tag 7
57	UNIT_SEL7	Unit Selection 7
58	DISPLAY_UNIT7	Display Unit 7
59	EXP_MODE7	Exponent Mode 7
60	BLOCK_TAG8	Block Tag 8
61	PARAMETER_SEL8	Parameter Selection 8
62	DISPLAY_TAG8	Display Tag 8
63	UNIT_SEL8	Unit Selection 8
64	DISPLAY_UNIT8	Display Unit 8
65	EXP_MODE8	Exponent Mode 8
66	BLOCK_TAG9	Block Tag 9
67	PARAMETER_SEL9	Parameter Selection 9
68	DISPLAY_TAG9	Display Tag 9
69	UNIT_SEL9	Unit Selection 9
70	DISPLAY_UNIT9	Display Unit 9
71	EXP_MODE9	Exponent Mode 9
72	BLOCK_TAG10	Block Tag 10
73	PARAMETER_SEL10	Parameter Selection 10
74	DISPLAY_TAG10	Display Tag 10
75	UNIT_SEL10	Unit Selection 10
76	DISPLAY_UNIT10	Display Unit 10
77	EXP_MODE10	Exponent Mode 10

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AI Function Block

Relative Index	Parameter Name	Label
0	BLOCK_HEADER	Characteristics
1	ST_REV	Static Revision
2	TAG_DESC	Tag Description
3	STRATEGY	Strategy
4	ALERT_KEY	Alert Key
5	MODE_BLK	Block Mode
6	BLOCK_ERR	Block Error
7	PV	Process Value
8	OUT	Output
9	SIMULATE	Simulation Wizard
10	XD_SCALE	Transducer Scale
11	OUT_SCALE	Output Scale
12	GRANT_DENY	Grant Deny
13	IO_OPTS	I/O Options
14	STATUS_OPTS	Status Options
15	CHANNEL	Channel
16	L_TYPE	Linearization Type
17	LOW_CUT	Low Cutoff
18	PV_FTIME	Process Value Filter Time
19	FIELD_VAL	Field Value
20	UPDATE_EVT	Update Event
21	BLOCK_ALM	Block Alarm
22	ALARM_SUM	Alarm Summary
23	ACK_OPTION	Acknowledge Option
24	ALARM_HYS	Alarm Hysteresis
25	HI_HI_PRI	High High Priority
26	HI_HI_LIM	High High Limit
27	HI_PRI	High Priority
28	HI_LIM	High Limit
29	LO_PRI	Low Priority
30	LO_LIM	Low Limit
31	LO_LO_PRI	Low Low Priority
32	LO_LO_LIM	Low Low Limit
33	HI_HI_ALM	High High Alarm
34	HI_ALM	High Alarm
35	LO_ALM	Low Alarm
36	LO_LO_ALM	Low Low Alarm
37	OUT_D_SEL	Output Discrete Select
38	OUT_D	Output Discrete

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10. GENERAL SPECIFICATIONS

10.1 Standard specifications

For items other than those described below, refer to each User's Manual.

Applicable Model:

EJX910A and EJX930A

Output:

Digital communication signal based on FOUNDATION Fieldbus protocol.

Supply Voltage:

9 to 32 V DC for general use, flameproof type and Type n

Communication Requirements:

Supply Voltage: 9 to 32 V DC

Current Draw (Stedy state): 15 mA (max)

Current Draw (Software Download state): 24 mA (max)

Response Time (for Primary Value)

EJX910A	L, M and H capsule	300 msec
EJX930A	M and H capsule	350 msec

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When amplifier damping is set to zero, and including dead time.

Update Period:

Differential Pressure: 200 msec

Static Pressure: 200 msec

Capsule Temperature: 1 sec

Amplifier Temperature: 1 sec

External Temperature: 800 msec

Flow: 200 msec

Integral Indicator (LCD display)

5-digit Numerical Display, 6-digit Unit Display and Bar graph. The indicator is configurable to display one or up to ten of the I/O signals periodically.

Functional Specifications:

Functional specifications for Fieldbus communication conform to the standard specifications (H1) of FOUNDATION Fieldbus.

Function Block:

Block name	Number	Execution time	Note
AI	5	30 mS	For differential pressure, static pressure and temperature
SC	1	30 mS	An Output of Signal Characterizer block is a non-linear function of the respective input. The function is determined by a table
IT	1	30 mS	Integrator block integrates a variable as a function of the time or accumulates the counts
IS	1	30 mS	Input Selector block provides selection of up to eight inputs and generate an output based on the configured action
AR	1	30 mS	Arithmetic block permits simple use of popular measurement math functions
PID	1	45 mS	Applicable when LC1 option is specified

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LM Function:

LM function is supported.

LM function is disabled when shipped.

10.2 Optional specifications

For items other than those described below, refer to each User's Manual.

Item	Description	Code
PID function	PID control function	**LC1**
Data configuration at factory	Software damping	**CC**
Software Download Function	Based on Fieldbus Foundation Specification (FF-883) Download class: Class1	**EE**
Advanced diagnostics *1	Multi-sensing process monitoring • Impulse line blockage detection *2 • Heat trace monitoring	**DG1**

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*1: This option code must be specified with option code **EE**.

*2: The change of pressure fluctuation is monitored and then detects the impulse line blockage. See TI 01C25A31-01E for detailed technical information required for using this function.

10.3 Optional specifications (For Explosion Protected type)

Item	Description	Code
Factory Mutual (FM)	FM Explosionproof Approval Applicable Standard: FM3600, FM3615, FM3810, ANSI/NEMA 250 Explosionproof for Class I, Division 1, Groups B, C and D, Dust-ignitionproof for Class II/III, Division 1, Groups E, F and G, in Hazardous locations, indoors and outdoors (NEMA 4X) Temperature class: T6, Amb. Temp.: –40 to 60°C (–40 to 140°F)	**FF1**
	FM Intrinsically Safe and Nonincendive Approval *2 Applicable Standard: FM3600, FM3610, FM3611, FM3810, ANSI/NEMA 250, IEC60079-27 Intrinsically Safe for Class I,II, & III, Division 1, Groups A,B,C,D,F & G, Entity, FISCO. Class I, Zone 0, AEx ia IIC, Enclosure: "NEMA 4X", Temp. Class: T4, Amb. Temp.: -40 to 60°C (-40 to 140°F). Intrinsically Apparatus Parameters : [FISCO (IIC)] Ui=17.5 V, Ii=380 mA, Pi=5.32 W, Ci=3.52 nF, Li=0 µH [FISCO (IIB)] Ui=17.5 V, Ii=460 mA, Pi=5.32 W, Ci=3.52 nF, Li=0 µH [Entity] Ui=24 V, Ii=250 mA, Pi=1.2 W, Ci=3.52 nF, Li=0 µH Sensor Circuit: Uo=6.51 V, Io=4 mA, Po=6 mW, Co=34 µF, Lo=500 mH Nonincendive for Class I, Division 2, Groups A, B, C and D, NIFW, FNICO Class I, Zone 2, Group IIC, NIFW, FNICO Class II, Division 2, Groups F&G, and Class III, Division 1 Enclosure: "NEMA 4X", Temp. Class: T4, Amb. Temp.: -40 to 60°C (-40 to 140°F) Nonincendive Apparatus Parameters : Vmax.= 32 V, Ci = 1.76 nF, Li = 0 µH	**FS15**
CENELEC ATEX	CENELEC ATEX (KEMA) Flameproof Approval Applicable Standard: EN 60079-0, EN 60079-1, EN 61241-0, EN 61241-1 Certificate: KEMA 07ATEX0109 II 2G, 2D Exd IIC T4, T5, T6 Ex tD A21 IP6X T85, T100, T120 Degree of protection : IP66 and IP67 Amb. Temp. (Tamb) for gas-proof : T4 ; –50 to 75°C (–58 to 167°F), T5; –50 to 80°C (–58 to 176°F), T6; –50 to 75°C (–58 to 167°F) Max. process Temp.(Tp): T4; 120°C (248°F), T5; 100°C (212°F), T6; 85°C (185°F) Max. surface Temp. for dust-proof : T85°C (Tamb: –40 to 40°C, Tp:85°C), T100°C (Tamb: –40 to 60°C, Tp:100°C), T120°C (Tamb: –40 to 80°C, Tp:120°C)	**KF21**
	CENELEC ATEX (KEMA) Intrinsically Safe Approval Applicable Standards: EN 60079-0:2006, EN 50020:2002, EN 60079-27:2006, EN 50284:1009, EN 50281-1-1:1998+A1 Certificate: KEMA 06ATEX0278X II 1GD Ex ia IIB/IIC T4 Type of protection: IP66 and IP67 Amb. Temp.: -40 to 60°C (-40 to 140°F) Max. Process Temp. (Tp) : 120°C (248°F) Electrical data: Supply/Output circuit (terminals + and -) [FISCO (IIC)] Ui=17.5V, Ii=380mA, Pi=5.32W, Ci=1.76nF, Li=0µH [FISCO (IIB)] Ui=17.5V, Ii=460mA, Pi=5.32W, Ci=1.76nF, Li=0µH [Entity] Ui=24V, Ii=250mA, Pi=1.2W, Ci=1.76nF, Li=0µH External Temperature Input circuit (connector) Uo=7.63V, Io=3.85mA, Po=8mW, Co=4.8nF, Lo=100 mH Max. Surface Temp. for dust-proof: T85°C (Tp:80°C), T100°C (Tp:100°C), T120°C (Tp:120°C)	**KS25**

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Item	Description	Code
Canadian Standards Association (CSA)	CSA Explosionproof Approval Certificate: 2014354 Applicable Standard: C22.2 No.0, C22.2 No.0.4, C22.2 No.0.5, C22.2 No.25, C22.2 No.30, C22.2 No.94, C22.2 No.60079-0, C22.2 No.60079-1, C22.2 No.61010-1-01 Explosion-proof for Class I, Groups B, C and D. Dustignition-proof for Class II/III, Groups E, F and G. When installed in Division 2, “SEAL NOT REQUIRED” Enclosure: TYPE 4X, Temp. Code: T6...T4 Ex d IIC T6...T4 Enclosure: IP66 and IP67 Max.Process Temp.: T4;120°C (248°F), T5;100°C (212 °F), T6; 85°C (185°F) Amb.Temp.:–50 to 75°C (–58 to 167°F) for T4, –50 to 80°C (–58 to 176°F) for T5, –50 to 75°C (–58 to 167°F) for T6	**CF1**
	CSA Intrinsically Safe Approval *3	—
IECEx Scheme *2	IECEx Flameproof Approval Applicable Standard: IEC 60079-0:2004, IEC60079-1:2003 Certificate: IECEx CSA 07.0008 Flameproof for Zone 1, Ex d IIC T6...T4 Enclosure: IP66 and IP67 Max.Process Temp.: T4;120°C (248°F), T5;100°C (212°F), T6; 85°C (185°F) Amb.Temp.:–50 to 75°C (–58 to 167°F) for T4, –50 to 80°C (–58 to 176°F) for T5, –50 to 75°C (–58 to 167°F) for T6	**SF2**

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*1: Applicable only for Australia, New Zealand area, Singapore and India.

*2: Applicable for electrical connection code **2, 4, 7** and **9** (EJX910A).

*3: Pending.

< Factory Setting >

Tag Number (Tag plate)		As specified in order
Software Tag (PD_TAG)		‘FT1001’ unless otherwise both Tag Number and Software Tag specified in order
Node Address		‘0xF5’ unless otherwise specified in order
Operation Functional Class		‘BASIC’ or as specified
Primary value *1	Output Mode (L_TYPE)	‘Direct’ unless otherwise specified in order
	Calibration Range (XD_SCALE) Lower/Higher Range Value	As specified in order
	Calibration Range Unit	Selected from mmH_2O, mmH_2O(68°F), mmHg, Pa, hPa, kPa, MPa, mbar, bar, gf/cm^2, kgf/cm^2, inH_2O, inH_2O(68°F), inHg, ftH_2O, ftH_2O(68°F) or psi. (Only one unit can be specified)
	Output Scale (OUT_SCALE) Lower/Higher Range Value	‘0 to 100%’ unless otherwise specified.
	Software Damping *2	‘2 seconds’ or as specified in order
Static pressure display range		‘0 to 25 MPa’ for EJX910A M and H capsule and ‘0 to 16 MPa’ for EJX910A L capsule, absolute value. ‘0 to 32 MPa’ for EJX930A. Measuring high pressure side.

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*1: Primary means differential pressure in case of differential pressure transmitters and pressure in case of pressure transmitters.

*2: To specify this item, /CC option is required.

APPENDIX 1. SIGNAL CHARACTERIZER (SC) BLOCK

The Signal Characterizer (SC) block is used to convert the values of input signals according to a line-segment function. The line-segment function is created using 21 points of the X/Y coordinates specified by the user. This function block can also be used as a transmission line for control signals and supports backward control.

Application

The Signal Characterizer block is primarily used if you wish for one of the following reasons to correct signals using the coordinates rather than a computational expression:

- The computational expression for correction in relation to input signals is complex
- The relationship between input signals and the signals after correction is only empirically known

A1.1 Schematic Diagram of Signal Characterizer Block

The following shows the schematic diagram of the Signal Characterizer block.

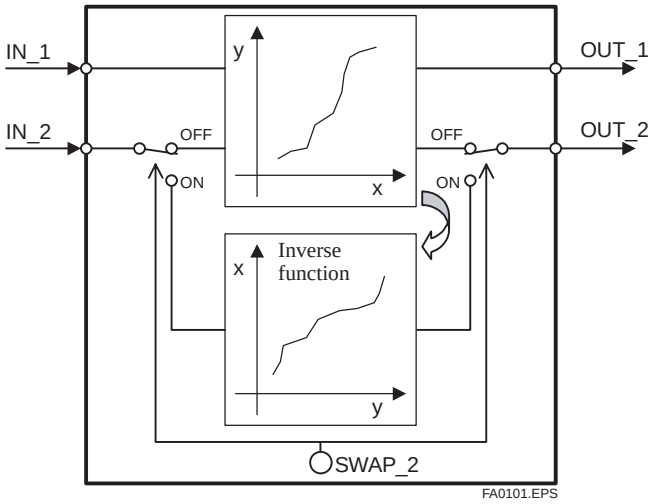

Figure A1.1 Signal Characterizer Block

Input/Output Parameters

Input	IN_1	Inputs a signal desired to be corrected using a line-segment function. (It is substituted for X of the line-segment function.)
	IN_2	Inputs a signal desired to be corrected using a line-segment function. (If SWAP_2 = off, it is substituted for X of the line-segment function.) (If SWAP_2 = on, it is substituted for Y of the line-segment function.)
Output	OUT_1	Outputs the result of the IN_1 input that has been corrected using the line-segment function. (The function block outputs the value of Y corresponding to IN_1.)
	OUT_2	Outputs the result of the IN_2 input that has been corrected using the line-segment function. The output can also be approximated using the inverse function of the specified line-segment function. (This is used for backward control.) (If SWAP_2 = off, the value of Y corresponding to X of IN_1 is output.) (If SWAP_2 = on, the value of X corresponding to Y of IN_1 is output.)
Others	CURVE_X	The points of the curve determining inputs and outputs. The x points of the curve are defined by an array of 1 to 21 points with a monotone increase. "+INFINITY" is configured for unused point(s).
	CURVE_Y	The points of the curve determining inputs and outputs. The y points of the curve are defined by an array of 1 to 21 points. If SWAP_2 = on, the elements of the curve are defined with a monotone increase or decrease. "+INFINITY" is configured for unused point(s).
	SWAP_2	Selector switch used to specify if an inverse function is used for the line-segment approximation of IN_2 to OUT_2. The setting of SWAP_2 = on (which uses the inverse function) is used for backward control.

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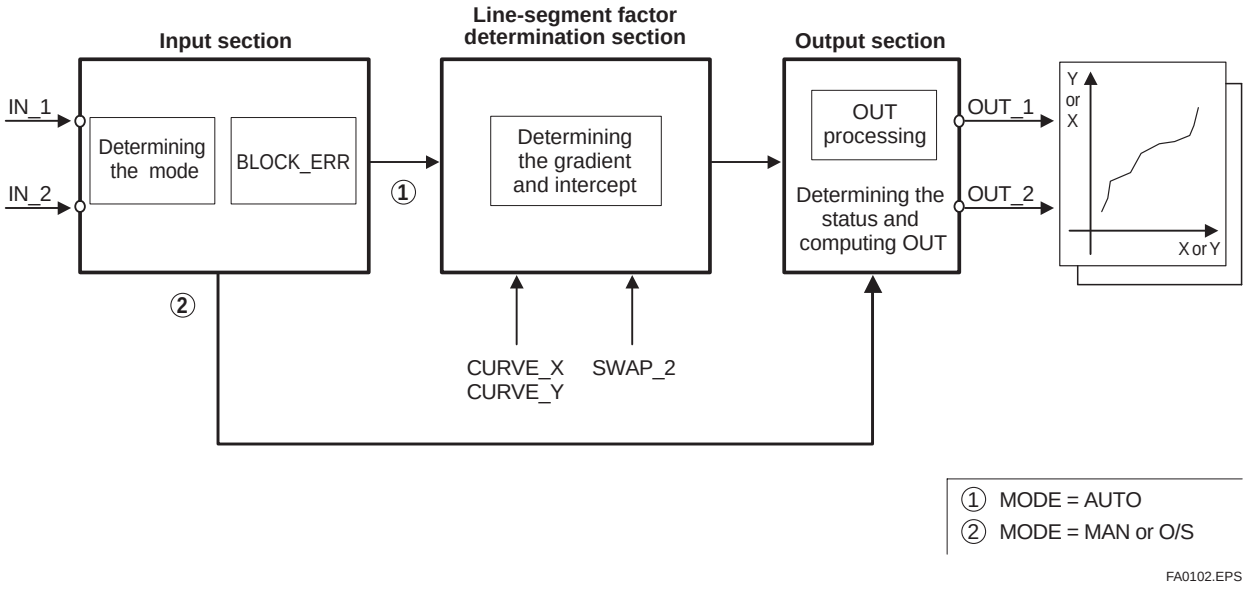

Figure A1.2 Overview of the Signal Characterizer Block

The following describes the Signal Characterizer block, dividing its functions into three sections:

- Input section: Determines the mode and judges BLOCK_ERR.
- Line-segment factor determination section: Determines the gradient and intercept for OUT_1 and OUT_2 based on CURVE_X, CURVE_Y, and SWAP_2 at shift ①.
- Output section: Multiplies the input values in IN_1 and IN_2 by the gradient and adds the intercept to them before outputting the results. Alternatively, it outputs a limit value.

A1.2 Input Section

The input section determines the mode and judges BLOCK_ERR.

A1.2.1 Determining the Mode

The following describes operations of the Signal Characterizer block.

Supported Mode	Rules
O/S (Out of Service)	• System-stopped status • Configuration change
Man	• If you do not want to output the value and the status from IN, you can manually transmit the value to OUT.
Auto	• Automatic system operation status

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A1.2.2 Judging BLOCK_ERR

BLOCK_ERR indicates the cause of an error in the function block. If the cause of an error indicated by BLOCK_ERR occurs, the following configuration error is generated.

Name	Description
Block Configuration Error	1) "−INFINITY" has been configured for CURVE_X and CURVE_Y. 2) "+INFINITY" has been configured for X1 of CURVE_X. 3) "+INFINITY" has been configured for Y1 of CURVE_Y. 4) A value of the array of CURVE_X does not increase in a monotone manner. 5) A configuration error when SWAP_2 is on • A value of the array of CURVE_Y does not increase or decrease in a monotone manner. 6) The value of SWAP_2 is any value other than 1 or 2.

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The mode changes to O/S if a block configuration error occurs.

A1.3 Line-segment Factor Determination Section

When the mode is AUTO and no bit in BLOCK_ERR is set, the "gradient" and "intercept" of a line passing through two points that are considered line-segment approximation values are determined.

A1.3.1 Conditions for Configuring Valid Coefficients (CURVE_X, CURVE_Y)

No write error is generated with respect to the settings in CURVE_X and CURVE_Y. However, a configuration error occurs in the following cases:

1. "+INFINITY" has been configured for X1 or Y1.
2. "−INFINITY" has been configured for each X or Y.
3. The values of CURVE_X are not increasing in a monotone manner (X1 < X2 < ... < X20 < X21).
   (If SWAP_2 is off, it is acceptable if the values of CURVE_Y do not increase or decrease in a monotone manner.)
4. The values of CURVE_Y are not increasing or decreasing in a monotone manner when SWAP_2 is on.

If a configuration error occurs, the Block Configuration Error bit in BLOCK_ERR is set, causing the mode to change to O/S.

Example of the case where SWAP_2 is off:

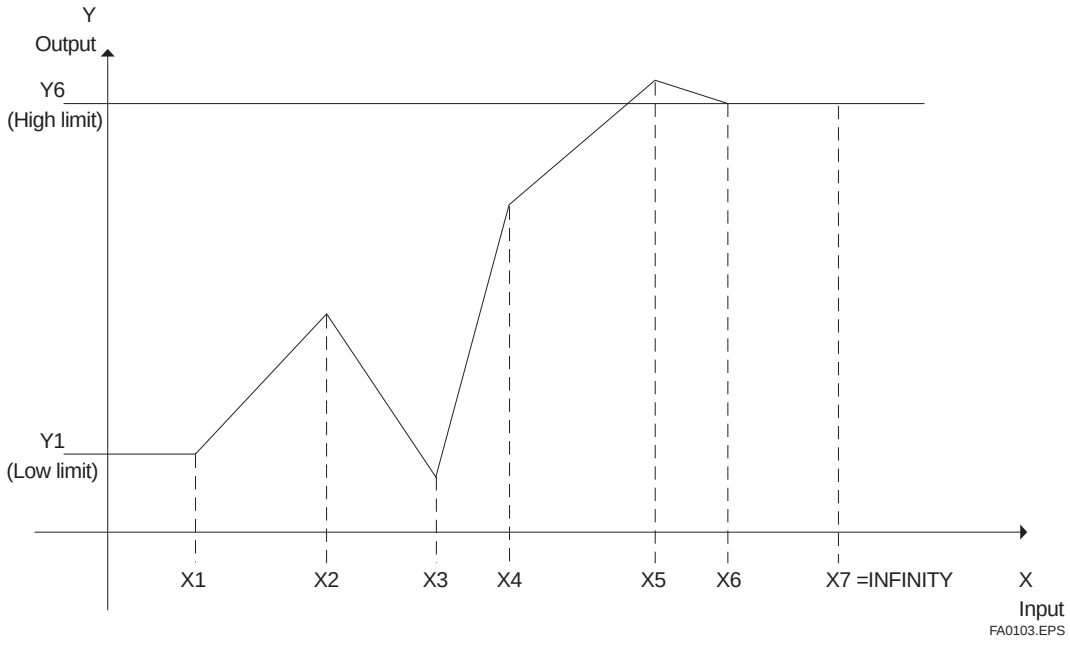

Figure A1.3 Example of Curve (SWAP_2 = off)

The range of CURVE_X: X1 to X6 (X7 and above are invalid because "+INFINITY" has been configured for X7*1.)

The X1 to X6 values always increase in a monotone manner (X1 < X2 < X3 < X4 < X5 < X6).

If an input value is smaller than X1, it is set to Y1.

If an input value is larger than X6, it is set to Y6.

The range of CURVE_Y: Y1 to Y6

It is acceptable if the Y1 to Y6 values do not increase in a monotone manner.

However, if the setting of SWAP_2 is changed from off to on, the values of CURVE_Y must increase or decrease in a monotone manner. Thus, if a value of CURVE_Y does not increase or decrease in a monotone manner in this setting, the mode changes to O/S, causing the Block Configuration Error bit in BLOCK_ERR to be set.

*1: For any points of the curve that are not used, configure "+INFINITY" for all of them.

Example of the case where SWAP_2 is on (monotone increase):

The input range of IN_1 is always in CURVE_X. The following shows the input/output graph of the IN_1 values.

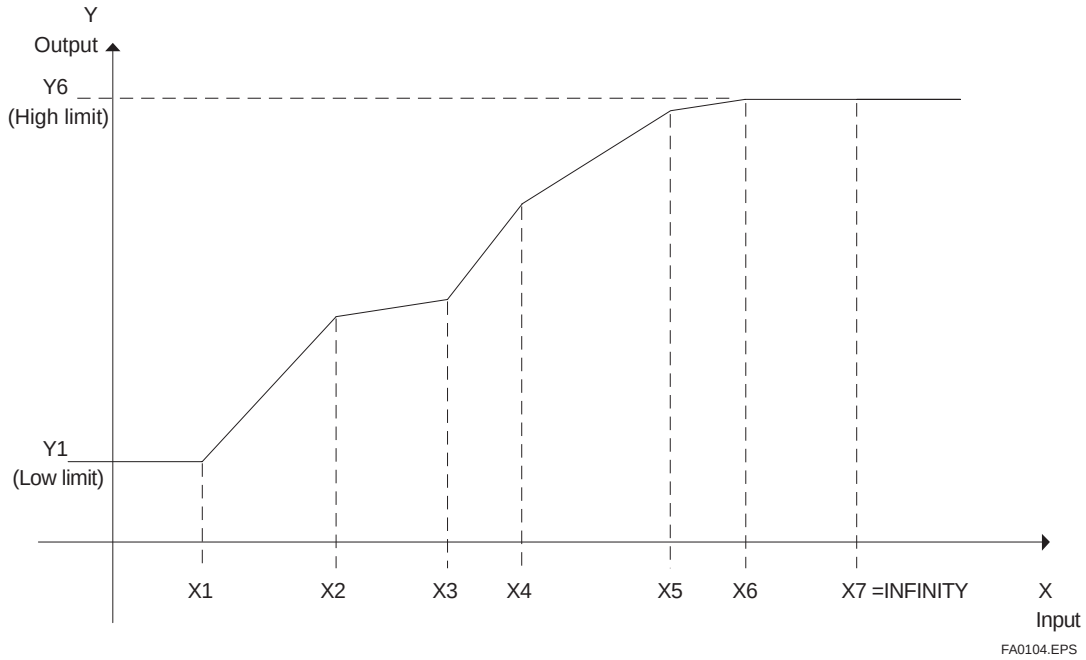

Figure A1.4 Example of Curve for IN_1 (SWAP_2 = on)

The input range of IN_2 is always in CURVE_Y. The following shows the input/output graph of the IN_2 values.

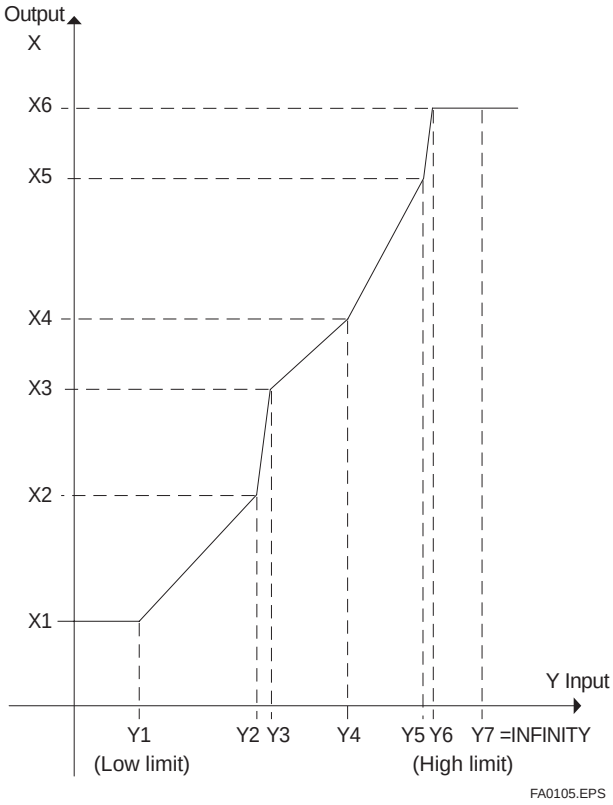

Figure A1.5 Example of Curve for IN_2 (SWAP_2 = on)

When SWAP_2 is on, the array elements of CURVE_Y must be configured for a monotone increase or decrease.

(Y1 < Y2 < Y3 < Y4 < Y5 < Y6 or Y6 < Y5 < Y4 < Y3 < Y2 < Y1)

A1.4 List of Signal Characterizer Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View				Description / Remarks
					1	2	3	4	
0	BLOCK_HEADER	Block Tag=O/S		TAG: "SC"					Information relating to this function block, such as block tag, DD revision, and execution time
1	ST_REV	--------			2	2	2	2	The revision level of the set parameters associated with the Signal Characterizer block
2	TAG_DESC			Null					Stores comments describing tag information.
3	STRATEGY			1				2	The strategy field can be used by the high-level system to identify function blocks.
4	ALERT_KEY		1-255	1				1	Key information used to identify the location at which an alert has occurred
5	MODE_BLK				4		4		Mode of the Signal Characterizer block. O/S, Man, and Auto are supported.
6	BLOCK_ERR				2		2		Indicates the error status of the Signal Characterizer block in bit strings.
7	OUT_1	MAN			5		5		Outputs the result of the value of IN_1 corrected using a line-segment function.
8	OUT_2	MAN			5		5		Outputs the result of the value of IN_2 corrected using a line-segment function. It is also possible to approximate the result using the inverse function of the specified line-segment function. (This is used for backward control.)
9	X_RANGE					11			The engineering unit of variables corresponding to the x-axis for display
10	Y_RANGE					11			The engineering unit of variables corresponding to the y-axis for display
11	GRANT_DENY					2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before being executed. After the operations are complete, the DENY parameter is checked for the setting of any bit relating to the corresponding operation. If no bit is set, it is evident that the operations have been executed successfully.
12	IN_1				5		5		Input a signal to be corrected using a line-segment function.
13	IN_2				5		5		Input a signal to be corrected using a line-segment function.
14	SWAP_2		0:Initialized 1:No swap 2:Swap					1	Selector switch used to apply the inverse function to line-segment approximation of IN_2 to OUT_2
15	CURVE_X								Curve input points that determine inputs and outputs. The "x" points of the curve are defined by an array of 1 to 21 points with a monotone increase.
16	CURVE_Y								Curve input points that determine inputs and outputs. The "y" points of the curve are defined by an array of 1 to 21 points. If SWAP_2 is on, the elements of the curve must be defined with a monotone increase or decrease.
17	UPDATE_EVT								Indicates event information if an update event occurs.
18	BLOCK_ALM								Indicates alarm information if a block alarm occurs.

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A1.5 Application Example

A1.5.1 Input Compensation

The following is an application example of pH compensation made by performing feedback control.

The pH is a value representing the degree of acidity or alkalinity and ranges from 0 to 14. pH 7 indicates neutral, a value smaller than 7 represents acidity, and a value larger than 7 denotes alkalinity. It is very difficult to control pH with a quickly changing reaction rate at a point near 7.

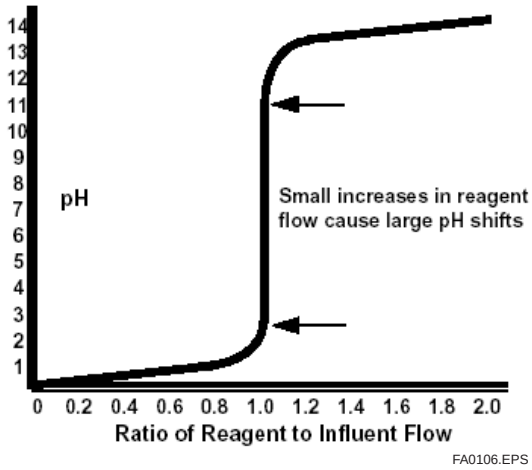

Figure A1.6 pH and Reagent Flow

To control this pH, the input is regulated using line-segment approximation, gain, and input compensation.

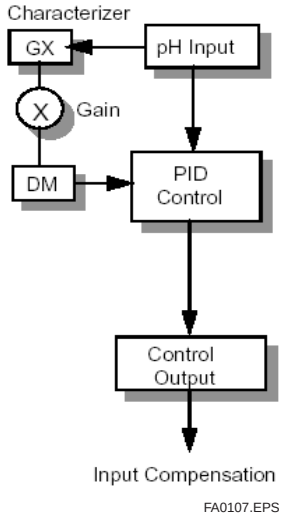

Figure A1.7 Input Compensation

The following shows the approximation-value graph of GX Output that is approximation-value output and GX Input that is pH input. pH with a quickly changing reaction rate can be controlled at a point near neutral 7 according to the following graph.

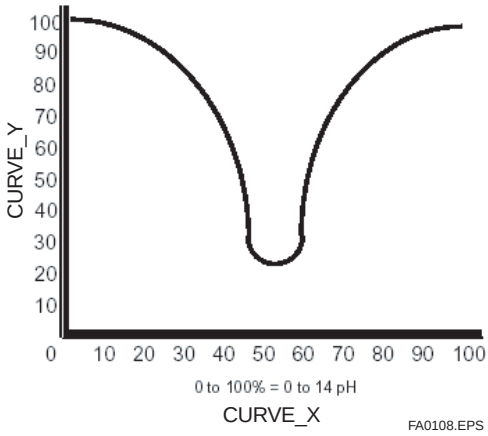

Figure A1.8 Approximation Curve

A1.5.2 Calorie Flow Compensation

AI_1: Inlet temperature, AI_2: Outlet temperature, AI_3: Flow rate
SC: Corrects the inlet and outlet temperatures.
AR: Calculates a calorie flow rate on the basis of the difference between the corrected inlet and outlet temperatures.

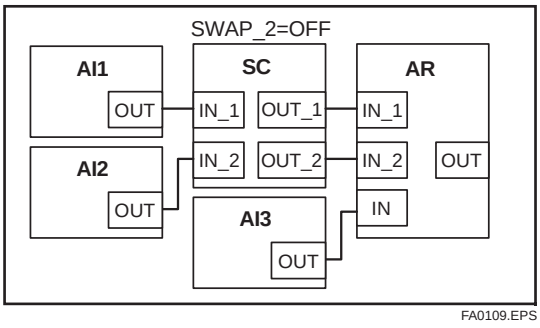

Figure A1.9 Calorie Flow Rate Compensation (SWAP_2 = Off)

A1.5.3 Backward Control

SC: The controlled variable output from PID is converted into an information quantity that can be interpreted by AO, and backward information from AO is converted into an information quantity that can be interpreted by PID before being transmitted to the PID.

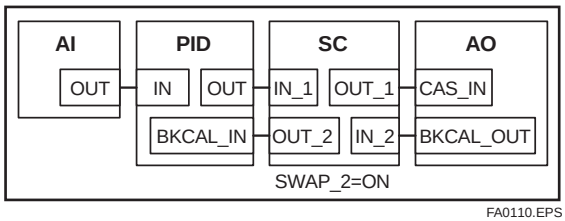

Figure A1.10 Backward Control (SWAP_2 = On)

To enable backward control (which inverts the X and Y axes), the line-segment function must be set so that the elements of the curve increase in a monotone manner.(As shown in Figure A1.11) If they do not increase in a monotone manner, the mode changes to O/S, disabling calculation.

No.	CURVE_X	CURVE_Y
1	5	5
2	10	10
3	15	11
4	20	20
5	25	25
6	30	26
7	35	30
8	40	40
9	45	45
10	50	50
11	51	51
12	52	54
13	53	59
14	54	66
15	55	75
16	65	80
17	75	81
18	80	85
19	85	86
20	90	90
21	95	95

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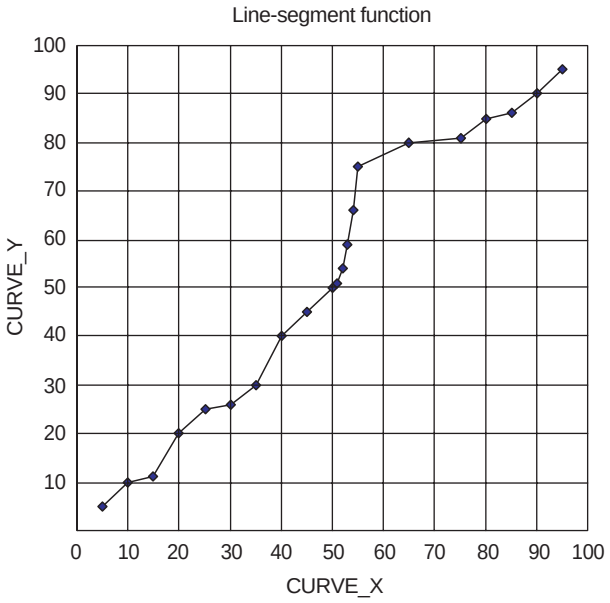

X_RANGE = 100, 0, %, 0x00
Y_RANGE = 100, 0, %, 0x00

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Figure A1.11 Setting Example of a Line-segment Function

APPENDIX 2. INTEGRATOR (IT) BLOCK

The Integrator (IT) block adds two main inputs and integrates them for output. The block compares the integrated or accumulated value to TOTAL_SP and PRE_TRIP and generates discrete output signals OUT_TRIP or OUT_PTRIP when the limits are reached.

The output is as represented by the following equation (for counting upward and rate conversion).

OUT.Value = Integration start value + Total
Total = Total + Current Integral
Current Integral = $(x + y) \times \Delta t$
x: IN_1 value whose unit has been converted
y: IN_2 value whose unit has been converted
Δt: block execution period

A2.1 Schematic Diagram of Integrator Block

The following shows the schematic diagram of the Integrator block.

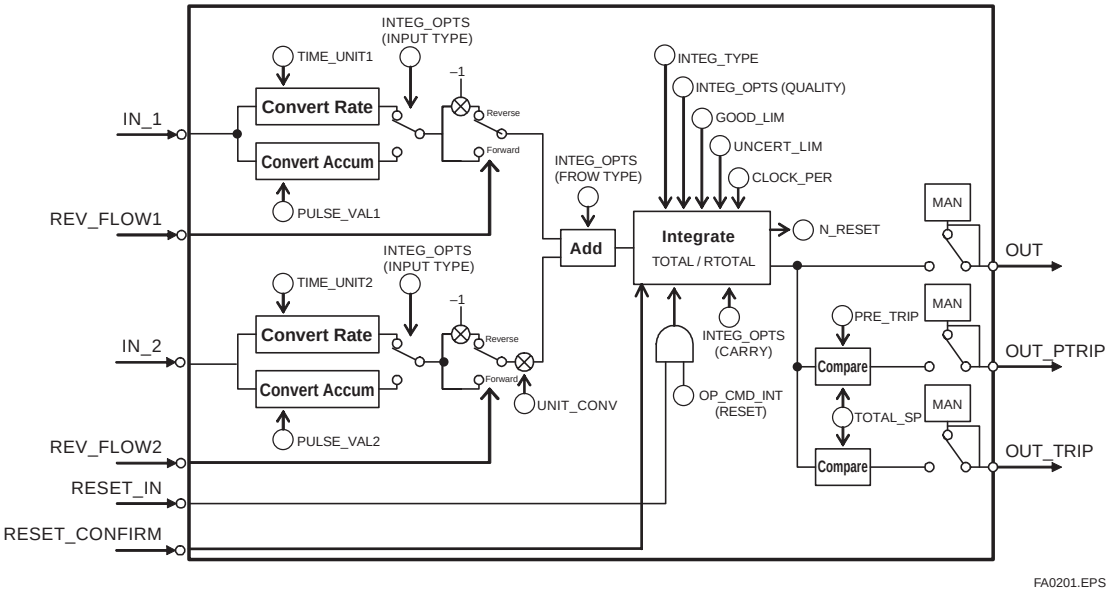

Figure A2.1 Integrator Block

IN_1: Block input 1 (value and status)
IN_2: Block input 2 (value and status)
REV_FLOW1: Indicates whether the sign of IN_1 is reversed. It is a discrete signal.
REV_FLOW2: Indicates whether the sign of IN_2 is reversed. It is a discrete signal.
RESET_IN: Resets the integrated values. It is a discrete signal.
RESET_CONFIRM: Reset confirmation input. It is a discrete signal.
OUT: Block output (value and status)
OUT_PTRIP: Set if the target value exceeds PRE_TRIP. It is a discrete signal.
OUT_TRIP: Set if the target value exceeds TOTAL_SP (or 0). It is a discrete signal.
The Integrator block is classified into the following five sections for each function:

- Input process section: Determines the input value status, converts the rate and accumulation, and determines the input flow direction.
- Adder: Adds the two inputs.
- Integrator: Integrates the result of the adder into the integrated value.
- Output process section: Determines the status and value of each output parameter.
- Reset process section: Resets the integrated values.

A2.2 Input Process Section

When executed, the Integrator block first performs input processing in the order of:

"Determining input status" → "Converting Rate or Accum" → "Determining the input flow direction"

Switching between Convert Rate and Convert Accum is made using bit 0 (for IN_1) or bit 1 (for IN_2) of INTEG_OPTS. INTEG_OPTS is one of the system parameters and should be set by the user. The values of IN_1 and IN_2 are not retained if the power is turned OFF.

A2.2.1 Determining Input Value Statuses

The following shows the correlation between the statuses of input parameters (IN_1, IN_2) and the statuses of input values used in the Integrator block.

Statuses of Input Parameters (IN_1, IN_2)	Bit 4 of INTEG_OPTS (Use Uncertain)	Bit 5* of INTEG_OPTS (Use Bad)	Status of Input Values Handled in IT Block
Good	Irrelevant	Irrelevant	Good
Bad	Irrelevant	H (=1)	Good
Bad	Irrelevant	L (=0)	Bad
Uncertain	H (=1)	Irrelevant	Good
Uncertain	L (=0)	Irrelevant	Bad

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For addition (see A2.3), if the status of an input value is "Bad," the "Good" value just before the status changed to "Bad" is used.

* Even if the Use Bad option is used, changing the internal status to "Good," the value of "Good" just before the status changed to "Bad" is used.

A2.2.2 Converting the Rate

The following describes an example of rate conversion.

In rate conversion, firstly convert the unit of two inputs to that based on seconds.
Next, convert the unit of the inputs to the same unit to be added together. The unit of IN_2 is standardized to that of IN_1. Then, calculates a weight, volume, or energy by multiplying each input value and block execution time. Because unit information is not input to the Integrator block as an input value, the user must input in advance tuned values to the TIME_UNIT1/2 and UNIT_CONV parameters.

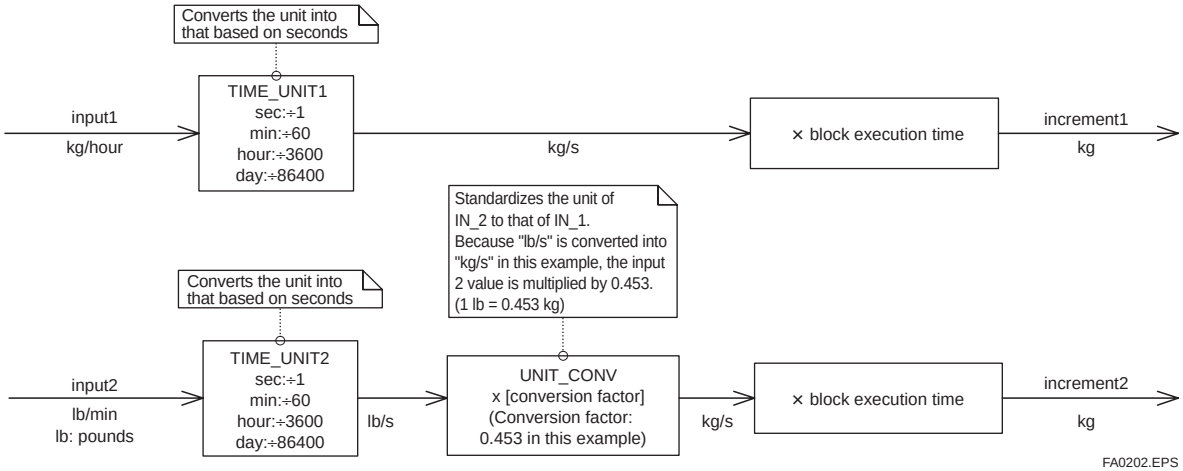

Figure A2.2 Increment Calculation with Rate Input

A2.2.3 Converting Accumulation

This following describes an example of accumulation conversion.

In accumulation conversion, the difference between the value executed previously and the value executed this time is integrated or accumulated. This conversion applies when the output of a function block used as a counter is input to the input process of the Integrator block.

In order to convert the rate of change of an input to a value with an engineering unit, the user must configure the factor of conversion to the appropriate engineering unit in the PULSE_VAL1 and PULSE_VAL2 parameters.

Moreover, the unit of IN_2 is standardized to that of IN_1 in the same way as rate conversion. Thus, the user must also set an appropriate value to UNIT_CONV.

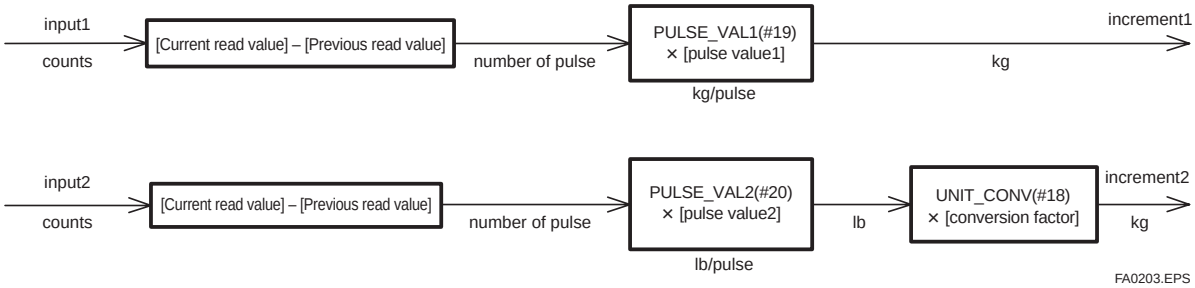

Figure A2.3 Increment Calculation with Counter Input

A2.2.4 Determining the Input Flow Direction

The Integrator block also considers the input flow direction. Information about the input flow direction is contained in REV_FLOW1 and REV_FLOW2 (0: FORWARD, 1: REVERSE).

In input processing, the sign of the value after rate and accumulation conversion is reversed if the REV_FLOW1 and REV_FLOW2 parameters are set to REVERSE. When determination of the flow direction of two input values is complete, these two inputs are passed to the adder. The settings in REV_FLOW will be retained even if the power is turned OFF.

A2.3 Adder

When input processing is complete, two arguments that have been rate and accumulate converted will be passed to the adder. The adder adds these two values according to the option.

A2.3.1 Status of Value after Addition

If one of the statuses of two arguments is "Bad" or if two of them are both "Bad," the status of the value after addition becomes "Bad." In this case, the value of "Good" just before the status changed to "Bad" is used as the addition value (see A2.1).

When the statuses of two arguments are both "Good," the status of the value after addition becomes "Good." In this case, the status of the value after addition will be used for the status applied to integration.

A2.3.2 Addition

The following three options are available for addition:

- TOTAL: Adds two argument values as is.
- FORWARD: Adds two argument values, regarding a negative value as "0."
- REVERSE: Adds two argument values, regarding a positive value as "0."

You can choose these options using bit 2 and bit 3 of INTEG_OPTS as follows:

Bit 2 of INTEG_OPTS (Flow Forward)	Bit 3 of INTEG_OPTS (Flow Reverse)	Adder Options
H	H	TOTAL
L	L	TOTAL
H	L	FORWARD
L	H	REVERSE

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The result of the adder is passed to the integrator. If only one of the inputs is connected, the value of a non-connected input will be ignored.

When bit 7 of INTEG_OPTS (Add zero if bad) has been set, if the status of a value after addition is "Bad," the value after addition (increment) becomes "0."

A2.4 Integrator

When addition is complete, its result will be passed to the integrator.

Integration consists of combinations of a reset method and counting up/down. There are the following seven integration types, which can be set using INTEG_TYPE.

1. UP_AUTO : Counts up with automatic reset when TOTAL_SP is reached
2. UP_DEM : Counts up with demand reset
3. DN_AUTO : Counts down with automatic reset when zero is reached
4. DN_DEM : Counts down with demand reset
5. PERIODIC : Counts up and is reset periodically according to CLOCK_PER
6. DEMAND : Counts up and is reset on demand
7. PER&DEM : Counts up and is reset periodically or on demand

Each type of integration is independently run as a function.

There are the following four types of integrated values:

1. Total: Integrates the result of the adder as is.
2. ATotal: Integrates the absolute value of the result of the adder.
3. RTotal: Integrates the absolute value of the result of the adder only if the status of the result is "Bad." This value is used for the RTOTAL value.
4. AccTotal: An extension function. The result of the adder is integrated as is and will not be reset.

The value is used for the ACCUM_TOTAL (expanded parameter) value.

The table A2.1 shows the details of INTEG_TYPE.

Table A2.1 INTEG_TYPE

Name	Integration Method	Integration Range	Reset Trigger (Reset if one of the following conditions is established)	Trip Output
UP_AUTO(1)	Counting up Starting from "0"	-INF< Total <TOTAL_SP 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• OUT reaches TOTAL_SP. • RESET_IN = 1 • OP_CMD_INT = 1	○
UP_DEM(2)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• RESET_IN = 1 • OP_CMD_INT = 1	○
DN_AUTO(3)	Counting down Starting from TOTAL_SP	0< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• OUT reaches "0." • RESET_IN = 1 • OP_CMD_INT = 1	○
DN_DEM(4)	Counting down Starting from TOTAL_SP	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• RESET_IN = 1 • OP_CMD_INT = 1	○
PERIODIC(5)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• At the period specified by CLOCK_PER • OP_CMD_INT = 1	×
DEMAND(6)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• RESET_IN = 1 • OP_CMD_INT = 1	×
PER&DEM(7)	Counting up Starting from "0"	-INF< Total <+INF 0< ATotal <+INF 0< RTotal <+INF -INF< AccTotal <+INF	• At the period specified by CLOCK_PER • RESET_IN = 1 • OP_CMD_INT = 1	×

Legend ○: Trip output is made. ×: No trip output is made.

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A2.5 Output Process

There are the following three output parameters:

1. OUT
2. OUT_TRIP
3. OUT_PTRIP

Parameters OUT_TRIP and OUT_PTRIP are used only when INTEG_TYPE is a value from 1 to 4.

A2.5.1 Status Determination

The same criteria for determining the status of the output of the Integrator block are used in common for the above three parameters.

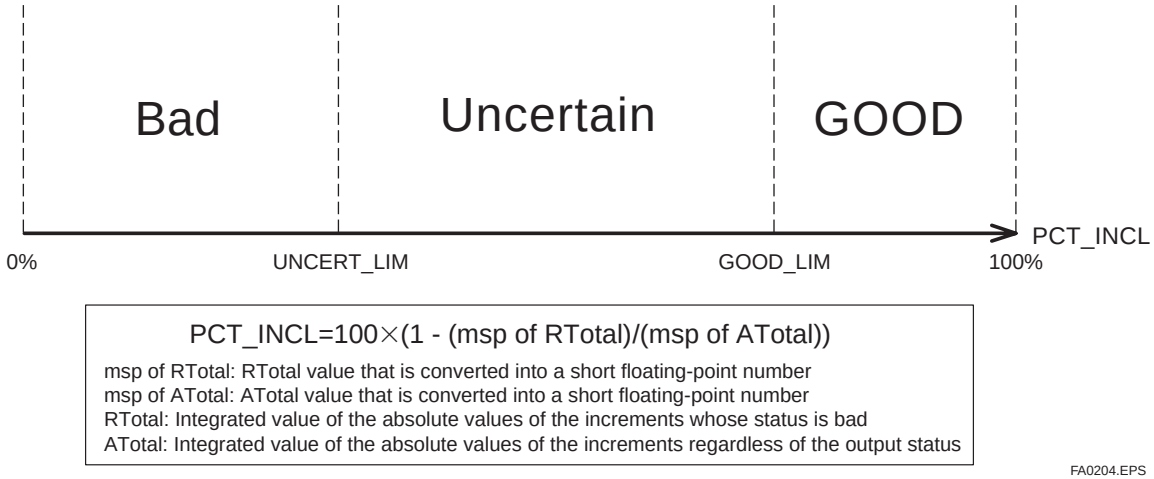
Bad
Uncertain
GOOD
PCT_INCL
0%
UNCERT_LIM
GOOD_LIM
100%
PCT_INCL=100×(1 - (msp of RTotal)/(msp of ATotal))
msp of RTotal: RTotal value that is converted into a short floating-point number
msp of ATotal: ATotal value that is converted into a short floating-point number
RTotal: Integrated value of the absolute values of the increments whose status is bad
ATotal: Integrated value of the absolute values of the increments regardless of the output status
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Figure A2.4 Status of OUT, OUT_TRIP, and OUT_PTRIP Outputs

OUT.Value, OUT_TRIP.Status, and OUT_PTRIP.Status are determined by the ratio of the "Good" integrated values to all integrated values, which is stored in PCT_INCL (0% to 100%). The user must set the threshold value of each status to UNCERT_LIM and GOOD_LIM.

The Integrator block determines the status of the output using the three parameters: PCT_INCL,

UNCERT_LIM, and GOOD_LIM.

- PCT_INCL≧GOOD_LIM
  ⇒Good
- UNCERT_LIM≦PCT_INCL＜GOOD_LIM
  ⇒Uncertain
- PCT_INCL＜UNCERT_LIM
  ⇒Bad

If INTEG_TYPE is 5, 6, or 7, the status of the trip output becomes "Good-NS-Constant."

A2.5.2 Determining the Output Value

The value of OUT.Value is determined as follows:

- For counting up

  OUT = integration start value (0) + Total

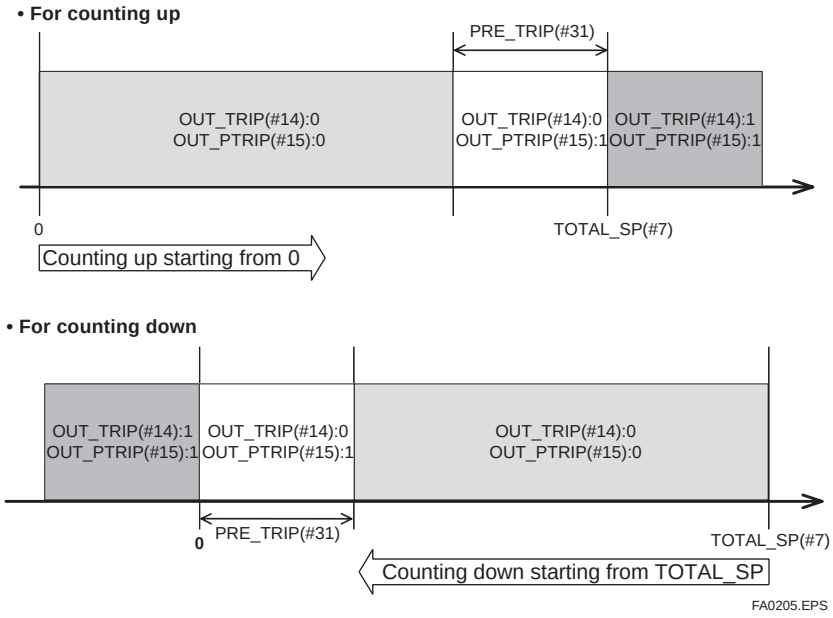
- For counting down

  OUT = integration start value (TOTAL_SP) _ Total

Total: Total of integrated values. This value is retained even if INTEG_TYPE is changed during integration (in AUTO).

If OUT is rewritten in the MAN mode, integration starts with the value rewritten in MAN mode after the mode was returned to AUTO.

The values in OUT_TRIP and OUT_PTRIP are determined according to the correlation between OUT and TOTAL_SP/PRE_TRIP.



For counting up, the OUT value is as follows:

- OUT < TOTAL_SP - PRE_TRIP
  ⇒OUT_TRIP = 0, COUT_PTRIP = 0
- TOTAL_SP - PRE_TRIP <= OUT < TOTAL_SP
  ⇒OUT_TRIP = 0, COUT_PTRIP = 1
- TOTAL_SP <= OUT
  ⇒OUT_TRIP = 1, COUT_PTRIP = 1

For counting down, the OUT value is as follows:

- PRE_TRIP < OUT
  ⇒OUT_TRIP = 0, COUT_PTRIP = 0
- 0 < OUT <= PRE_TRIP
  ⇒OUT_TRIP = 0, COUT_PTRIP = 1
- OUT <= 0
  ⇒OUT_TRIP = 1, COUT_PTRIP = 1

Note that the given conditions do not apply to the following cases:

- If INTEG_TYPE is 5, 6, or 7, OUT_TRIP and OUT_PTRIP always output "0."
- If INTEG_TYPE is 1 or 3, occurrence of AutoRESET (reset caused if the threshold is exceeded) causes OUT_TRIP to hold "1" for five seconds.

A2.5.3 Mode Handling

Mode	Action	Output
Automatic (AUTO)	Normal action	Normal output
Manual (MAN)	Integration calculation is stopped. OUT will not be updated unless you set a value to it. No reset is accepted.	You may rewrite a value in OUT. If no value is rewritten, the value just before running in AUTO is held. When the mode returns to AUTO, integration starts with the written value or the value just before running in AUTO.
Out of Service (O/S)		

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If you rewrite the value in OUT and RTOTAL while the mode is in MAN or O/S, N_RESET is incremented.

A2.6 Reset

A2.6.1 Reset Trigger

There are the following five types of reset triggers:

1. An integrated value exceeds TOTAL_SP.
2. An integrated value falls below "0."
3. RESET_IN is "H."
4. Every period specified in CLOCK_PER (for more information, see CLOCK_PER in A2.6.2)
5. OP_CMD_INT is 1.

The table A2.2 shows the correlation between INTEG_TYPE and RESET triggers.

Table A2.2 RESET Triggers

	(1)	(2)	(3)	(4)	(5)
1:UP_AUTO	○	×	○	×	○
2:UP_DEM	×	×	○	×	○
3:DN_AUTO	×	○	○	×	○
4:DN_DEMO	×	×	○	×	○
5:PERIODIC	×	×	×	○	○
6:DEMAND	×	×	○	×	○
7:PER&DEM	×	×	○	○	○

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When OP_CMD_INT has become "H" and a reset was made, OP_CMD_INT automatically returns to "L."

Even if RESET_IN becomes "H," activating a reset, RESET_IN does not automatically return to "L." The RESET_IN setting will not be retained if the power is turned OFF.

A2.6.2 Reset Timing

All items are reset during execution of the function block. Therefore, the minimum period of a reset is the block execution period.

● 5-second rule

If a reset is made, the next reset will not be accepted for 5 seconds after that.

Even if UP_AUTO (or DN_AUTO) is activated and TOTAL_SP (or 0) is reached within 5 seconds, the next reset will not be made for 5 seconds from the previous reset.

● CLOCK_PER

If INTEG_TYPE is PERIODIC (5) or PER&DEM (7), a reset is made at the period (sec) set to the CLOCK_PER parameter.

If the value in CLOCK_PER is smaller than the function block's execution period, bit 1 of BLOCK_ERR "Block Configuration Error" is set.

A2.6.3 Reset Process

The basic reset process sequence is as follows:

1.) Snapshot

2.) Clearing the integrated values

3.) Reset count increment

4.) Judging OUT_TRIP and OUT_PTRIP (see A2.5)

1.) Snapshot

Saves the following values in the specified parameters before clearing the integrated values. These values will be retained until the next reset is made.

STOTAL = Total

SRTOTAL = RTotal

SSP = TOTAL_SP

2.) Clearing the integrated values

The reset process clears the Total, ATotal, and RTotal values in the internal registers.

Total = 0

ATotal = 0

RTotal = 0

3.) Reset count increment

Each time a reset is made, the N_RESET parameter will be incremented.

The high limit is 999,999, and if this limit is exceeded, the count returns to "0."

4.) Judging OUT_TRIP and OUT_PTRIP (see A2.5)

OUT_TRIP and OUT_PTRIP are judged again on the basis of the cleared integrated values.

There are three options relating to a reset:

i Confirm reset (bit 8 of INTEG_OPTS)

ii Carry (bit 6 of INTEG_OPTS)

iii Generate reset event (bit 9 of INTEG_OPTS)

i Confirm reset (bit 8 of INTEG_OPTS)

If this option is enabled, the next reset is rejected until "1" is set to RESET_CONFIRM.

ii Carry (bit 6 of INTEG_OPTS)

If this option is enabled while INTEG_TYPE is UP_AUTO or DN_AUTO, the value exceeding the threshold at a reset will be carried into the next integration.

If INTEG_TYPE is any setting other than UP_AUTO or DN_AUTO, this option is irrelevant.

iii Generate reset event (bit 9 of INTEG_OPTS)

If this option is enabled, an alert event is generated if a reset occurs.

A2.7 List of Integrator Block Parameters

Index	Parameter Name	Initial Value	Write Mode	View 1	View 2	View 3	View 4	Definition
0	BLOCK_HEADER	TAG: "IT"	Block Tag =o/s					Information relating to this function block, such as block tag, DD revision, execution time
1	ST_REV	0	---	2	2	2	2	The revision level of the set parameters associated with the Integrator block
2	TAG_DESC	Nu11						Stores comments describing tag information.
3	STRATEGY	1					2	The strategy field is used by a high-level system to identify the function block.
4	ALERT_KEY	1					1	Key information used to identify the location at which an alert occurred
5	MODE_BLK			4		4		Integrator block mode. O/S, MAN, and AUTO are supported.
6	BLOCK_ERR		---	2		2		Indicates the active error conditions associated with the function block in bit strings.
7	TOTAL_SP	1000000.0		4		4		The setpoint of an integrated value or a start value for counting down
8	OUT		MAN	5		5		The block output
9	OUT_RANGE	1000000.0 0.0 m3(1034) 0			11			Set scaling for output display. This does not affect operation of the function block. It is used for making memos.
10	GRANT_DENY	0			2			The parameter for checking if various operations have been executed
11	STATUS_OPTS	0	OS				2	Allows you to select a status-related option. The Integrator block uses "Uncertain if Man mode" only.
12	IN_1	0.0		5		5		Inputs flow (Rate, Accum) signals from the AI block or PI block.
13	IN_2	0.0		5		5		
14	OUT_TRIP	0		2		2		An output parameter informing the user that the integrated value has exceeded the setpoint
15	OUT_PTRIP	0		2		2		An output parameter informing the user that the integrated value is reaching the setpoint
16	TIME_UNIT1	sec(1)	MAN		1			Set the time unit of the rate (kg/s, lb/min, kg/h ... etc.) of the corresponding IN.
17	TIME_UNIT2	sec(1)	MAN		1			
18	UNIT_CONV	1.0					4	Specify the unit conversion factor for standardizing the unit of IN_2 into that of IN_1.
19	PULSE_VAL1	1.0	MAN				4	Set the factor for converting the number of pulses for the corresponding IN into an appropriate engineering unit.
20	PULSE_VAL2	1.0	MAN				4	
21	REV_FLOW1	0		2		2		Selector switch used to specify the fluid flow direction (forward/reverse) with respect to the corresponding IN
22	REV_FLOW2	0		2		2		
23	RESET_IN	0		2		2		The parameter that receives a reset request from an external block to reset the integrated values
24	STOTAL	0.0				4		Indicates the snapshot of OUT just before a reset.
25	RTOTAL	0.0	MAN	4		4		Indicates the integrated value of the absolute values of the increments if the input status is "Bad."
26	SRTOTAL	0.0				4		Indicates the snapshot of RTOTAL just before a reset.
27	SSP	0.0				4		Indicates the snapshot of TOTAL_SP just before a reset.
28	INTEG_TYPE	UP_AUTO (1)					1	Integration Type Setting
29	INTEG_OPTS	0×0004					2	Specifies an integration optional function.

Integration Type Setting

Value	Name	Description
1	UP_AUTO	Counts up and is automatically reset when TOTAL_SP is reached.
2	UP_DEM	Counts up and is reset as demanded.
3	DN_AUTO	Counts down and is automatically reset when "0" is reached.
4	DN_DEM	Counts down and is reset as demanded.
5	PERIODIC	Counts up and is reset at periods specified in CLOCK_PER.
6	DEMAND	Counts up and is reset as demanded.
7	PER&DEM	Reset periodically or as demanded.

Specifies an integration optional function.

bit	Option Name	Description
0	Input 1 accumulate	Selects Rate or Accum input of IN_1.
1	Input 2 accumulate	Selects Rate or Accum input of IN_2.
2	Flow forward	Integrates forward flow (interprets reverse flow as zero).*
3	Flow reverse	Integrates reverse flow (interprets forward flow as zero).*
4	Use uncertain	Uses an input value of IN_1 or IN_2 whose status is "Uncertain" regarding it as a value of "Good."
5	Use bad	Uses an input value of IN_1 or IN_2 whose status is "Bad" regarding it as a value of "Good."
6	Carry	Carries over an excess exceeding the threshold at reset to the next integration. (Note that this does not apply to UP_AUTO or DN_AUTO.)
7	Add zero if bad	Interprets an increment as zero if the status of the increment is "Bad."
8	Confirm reset	After a reset, rejects the next reset until "Confirm" is set to RESET_CONFIRM.
9	Generate reset event	Generates an alert event at reset.
10~15	Reserved	

* If both forward and reverse flows are enabled or disabled, both forward and reverse flows are integrated.

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Index	Parameter Name	Initial Value	Write Mode	View				Definition
				1	2	3	4	
30	CLOCK_PER	86400.0[sec]					4	Specify the period at which a periodic reset is made.
31	PRE_TRIP	100000.0					4	Set an allowance applied before an integrated value exceeds the setpoint.
32	N_RESET	0.0		4		4		Indicates the number of resets in the range of 0 to 999999.
33	PCT_INCL	0.0[%]		4		4		The ratio of "the integrated values of the absolute values of the increments whose status is Good" to the "integrated values of the absolute values of the increments irrelevant to the status" (Equation)
34	GOOD_LIM	0.0[%]					4	The threshold value of the ratio of "the integrated values of the increments whose status is Good" to all integrated values in which the status of OUT is "Good"
35	UNCERT_LIM	0.0[%]					4	The threshold value of the ratio of "the integrated values of the increments whose status is Good" to all the integrated values in which the status of OUT is "Uncertain"
36	OP_CMD_INT	0		1		1		Operator command that resets integrated values
37	OUTAGE_LIM	0.0					4	Maximum time for which values can be retained in the event of power failure. It does not effect the block operation.
38	RESET_CONFIRM	0		2		2		Reset confirmation input, which is enabled when the Confirm reset option of INTEG_OPTS is chosen
39	UPDATE_EVT	1 1 0 0 0						Indicates event information if an update event occurs.
40	BLOCK_ALM	1 1 0 0 0						Indicates alarm information if a block alarm occurs.
41	ACCUM_TOTAL	0.0				4		Accumulated integrated values (no extension parameter is reset)

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APPENDIX 3. INPUT SELECTOR (IS) BLOCK

The function of the Input Selector (IS) block is to automatically select one signal from multiple input signals using a specified selection method.

The IS block is used for selective control in which one measured quantity is selected from multiple measured quantities to be transmitted to the controller as a controlled variable. This feature is primarily used for temperature control systems.

A3.1 Input Selector Function Block Schematic

The following shows the Input Selector function block schematic.

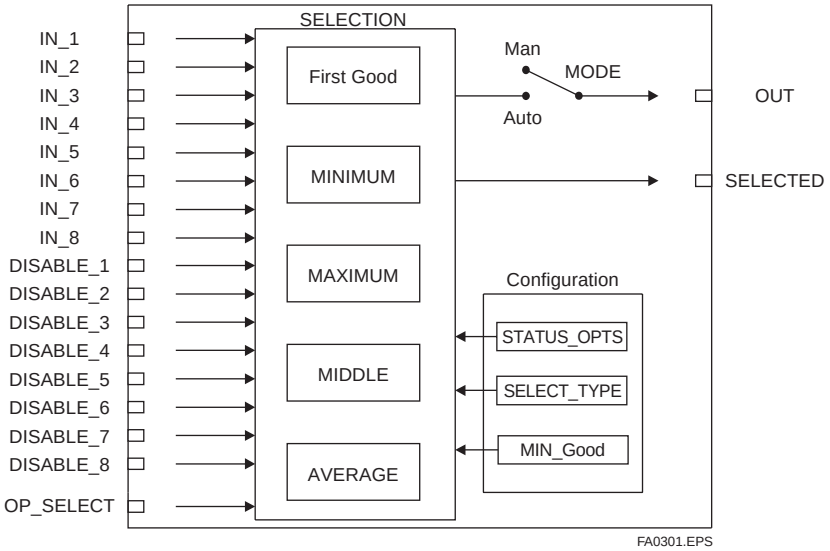

Figure A3.1 IS Block

Input Parameters (Input Terms)

IN_1 : Block input 1

IN_2 : Block input 2

IN_3 : Block input 3

IN_4 : Block input 4

IN_5 : Block input 5

IN_6 : Block input 6

IN_7 : Block input 7

IN_8 : Block input 8

DISABLE_1 : Selector switch 1 to disable input 1 from being selected

DISABLE_2 : Selector switch 2 to disable input 2 from being selected

DISABLE_3 : Selector switch 3 to disable input 3 from being selected

DISABLE_4 : Selector switch 4 to disable input 4 from being selected

DISABLE_5 : Selector switch 5 to disable input 5 from being selected

DISABLE_6 : Selector switch 6 to disable input 6 from being selected

DISABLE_7 : Selector switch 7 to disable input 7 from being selected

DISABLE_8 : Selector switch 8 to disable input 8 from being selected

OP_SELECT : A parameter which can be set by an operator to forcibly employ the input of the selected number

Output Parameters (Computation or Selection Results)

OUT: Block output

SELECTED: Indicates the input number selected using the alternatives.

Other Parameters

OUT_RANGE : Sets the OUT range.

STATUS_OPTS : Option used to specify the handling of various statuses.

SELECT_TYPE : Determines the input selection algorithm.

MIN_GOOD : Parameter specifying the minimum required number of inputs with “good” status. If the number of inputs that are “good” is less than the value of MIN_GOOD, input selection is canceled.

Mode

O/S : Allows configuration change, but disables input value output.

Man : Allows internal processing, but the output value may vary depending on the definition of usage conditions.

Auto : Outputs the input value.

The Input Selector (IS) block offers a maximum of eight input alternatives and generates the output according to the configured action. This block generally receives inputs from the Analog Input (AI) function block. The function of the IS block is to select a maximum, minimum, middle, average, “first good,” or “latched good” signal. The block combines parameter configuration (DISABLE_n) and option (“first good”) to give priority to alternative(s) or to function as a rotary position switch. When used as a rotary position switch, the block can receive operator inputs or switch information from connected inputs.

The IS block supports the concept of middle selection. This function outputs the average of two middle signals if even multiple valid signals are configured or a middle signal if odd multiple valid signals are configured. Application of the block is to supply a selected control signal in the forward path.

The SELECTED parameter is the 2nd output indicating which input has been selected using the algorithm.

A3.2 Input Section

A3.2.1 Mode Handling

The Input Selector block's operations are determined by the mode (parameter name: MODE_BLK). The following describes operations in each mode.

Supported Mode	Role
O/S (Out of Service)	· System-stopped status · Allows you to make changes to configuration.
Man	· If you do not want to output the value and status from IN or if the value or status thus output is not preferable, you can manually transmit the value to OUT.
Auto	· Automatic system operation status

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Valid Input

When the following conditions are satisfied, the value of IN_n becomes valid.

1) The QUALITY in each status of IN_n is either Good (NC), Good (C), or Uncertain[*1, 3].
2) The values of DISABLE_n corresponding to each IN_n are OFF and the QUALITY in the status of which is either Good (NC), Good (C), or Uncertain[*1, 2]
3) The number of inputs that are "good" is greater than the value of MIN_GOOD[*4].

Note: *1: Uncertain is applicable when "Use Uncertain as Good" is selected in the STATUS_OPTS parameter.
*2: If the status of DISABLE_n is Bad or Uncertain, its quality is lower so that the status of IN_n is also defined as lower quality. When DISABLE_n is ON, the value of IN_n becomes invalid. For the priority of DISABLE_n is higher than that of IN_n.

Status in SELECT_TYPE except OP_SELECT

QUALITY of DISABLE / IN Status	IN
Good (NC)	Valid
Good (C)	Valid
Uncertain[*1]	Valid
Uncertain	Invalid
Bad	Invalid

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Condition: The number of inputs that are "good" is greater than the value of MIN_GOOD
*3: Priority of IN_n when the same value is input

Priority 1:Highest 8:Lowest	Input
1	IN_1
2	IN_2
3	IN_3
4	IN_4
5	IN_5
6	IN_6
7	IN_7
8	IN_8

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*4: Refer to A3.2.2 for the details of MIN_GOOD.

A3.2.2 MIN_GOOD Handling

If there is no selectable input or if the number of selectable inputs is less than the value of MIN_GOOD, SELECTED becomes “0.”

A case where the number of valid INs is less than the value of MIN_GOOD:

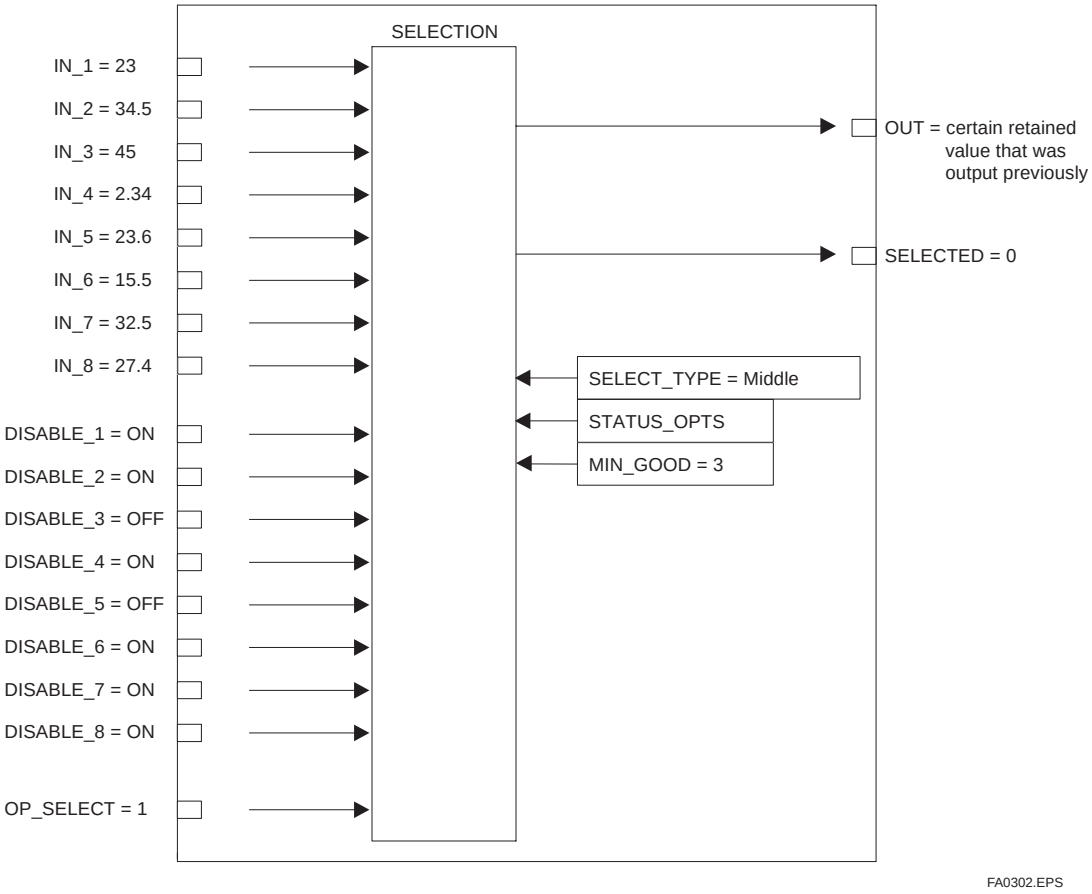

Figure A3.2 Example (1)

This example restricts the valid inputs using DISABLE_n, and the inputs are enabled only at DISABLE_3 and DISABLE_5. Because the effective number of MIN_Good is 3, the input specified by OP_SELECT will not be output.

A3.3 Selection

The following processing is performed after completing input processing. If the number of valid inputs is less than the value of MIN_Good, no input selection is made.

A3.3.1 OP_SELECT Handling

When a value other than “0” (that is, 1 to 8) is selected for OP_SELECT:

The IS block selects the input of the number specified by OP_SELECT regardless of the setting of SELECT_TYPE, propagates the value of that input to OUT, and transmits the input number to SELECTED.

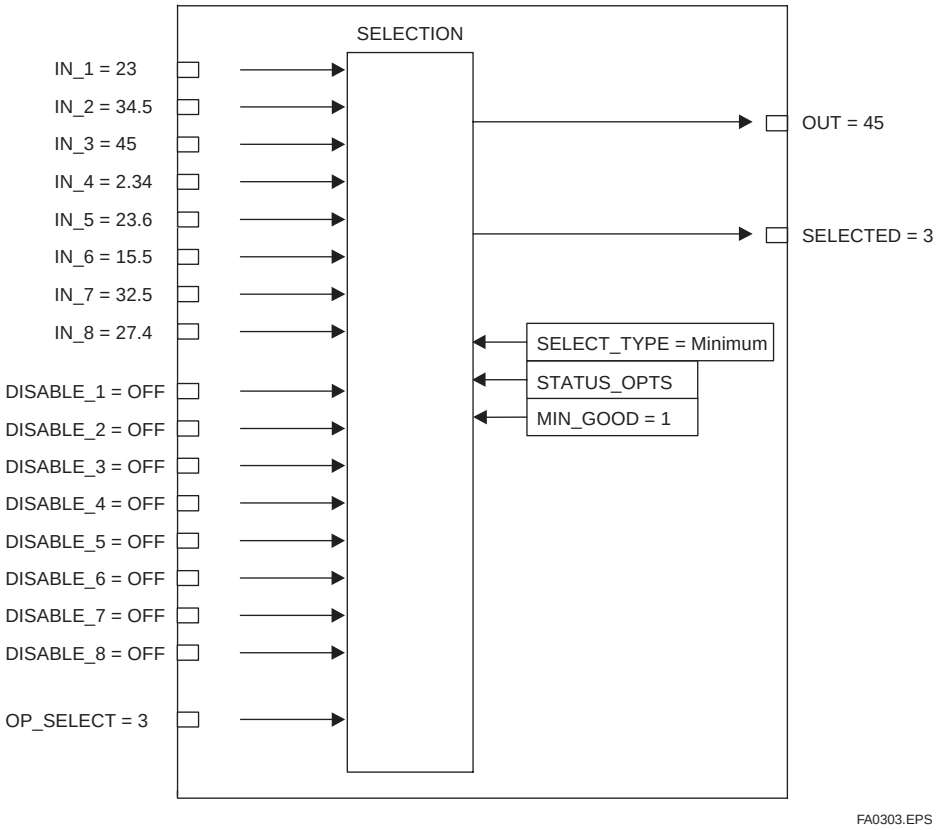

Figure A3.3 Example (2)

In the above example, SELECT_TYPE is set to Minimum. However, because OP_SELECT specifies the value and number of IN_3, the value and number of this specified IN are transmitted to OUT and SELECTED.

* Note: Even if the IN specified by OP_SELECT is an invalid input (the corresponding DISABLE parameter is ON or the IN’s status is “bad”), the value and status of that IN are transmitted to OUT.

A3.3.2 SELECTION Handling

If the value of OP_SELECT is “0,” input selection using SELECT_TYPE is enabled.

When SELECT TYPE is “first good”

The IS block selects the input with the smallest input number among valid inputs and transmits the value of that input to OUT. The number of the selected input is transmitted to SELECTED.

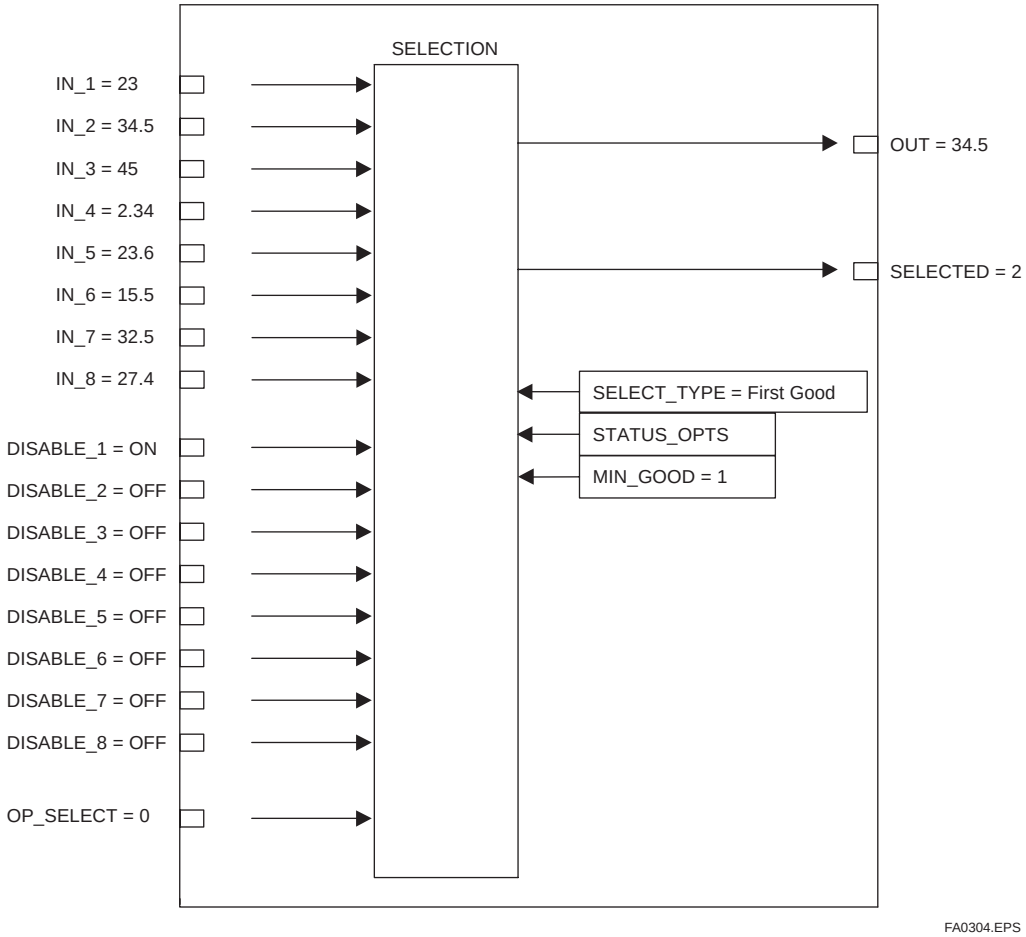

Figure A3.4 Example (3)

Because DISABLE_1 is ON, IN_1 is disabled, and IN_2 is selected for output. If DISABLE_1 is turned OFF, the output changes from IN_2 to IN_1. That is, the valid IN with the smaller input number is always selected for output.

When SELECT TYPE is “Minimum”

The IS block selects the input with the minimum value among valid inputs and transmits the value of that input to OUT. The number of the selected input is transmitted to SELECTED.

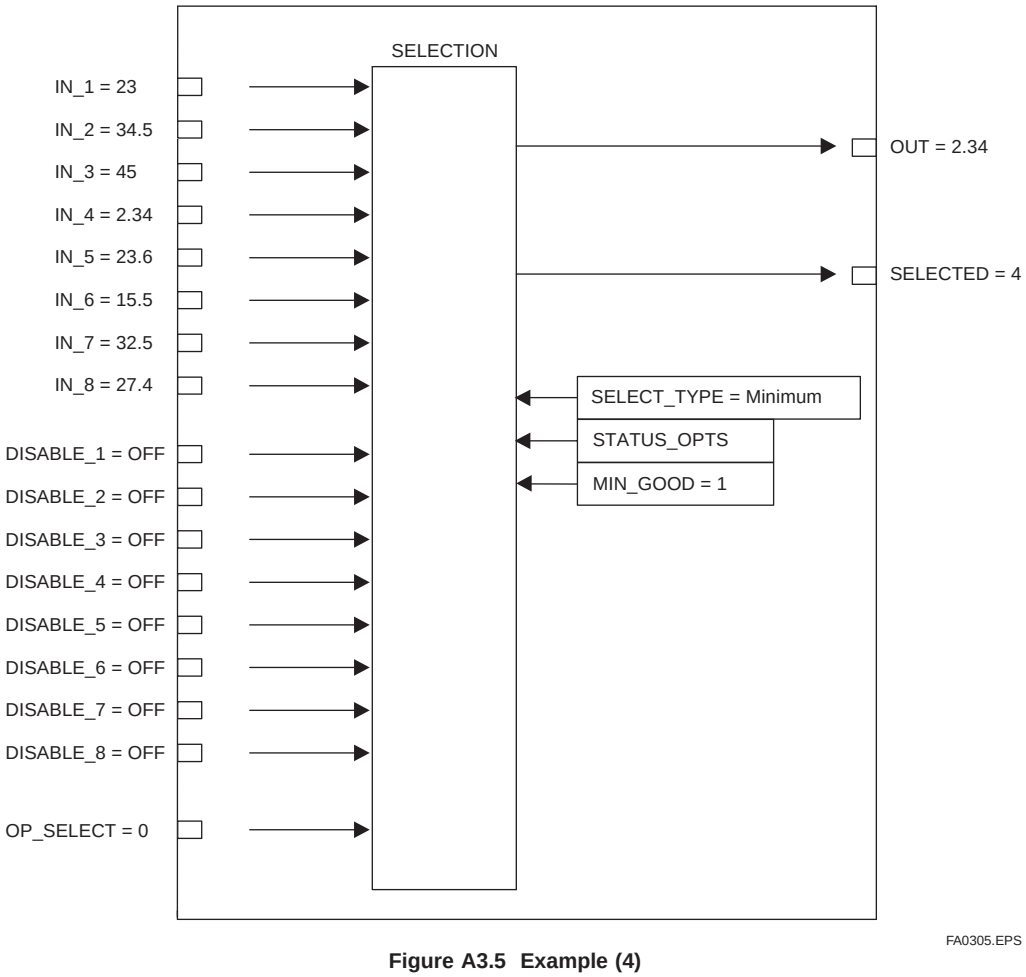

Figure A3.5 Example (4)

When SELECT TYPE is “Maximum”

The IS block selects the input with the maximum value among valid inputs and transmits the value of that input to OUT. The number of the selected input is transmitted to SELECTED.

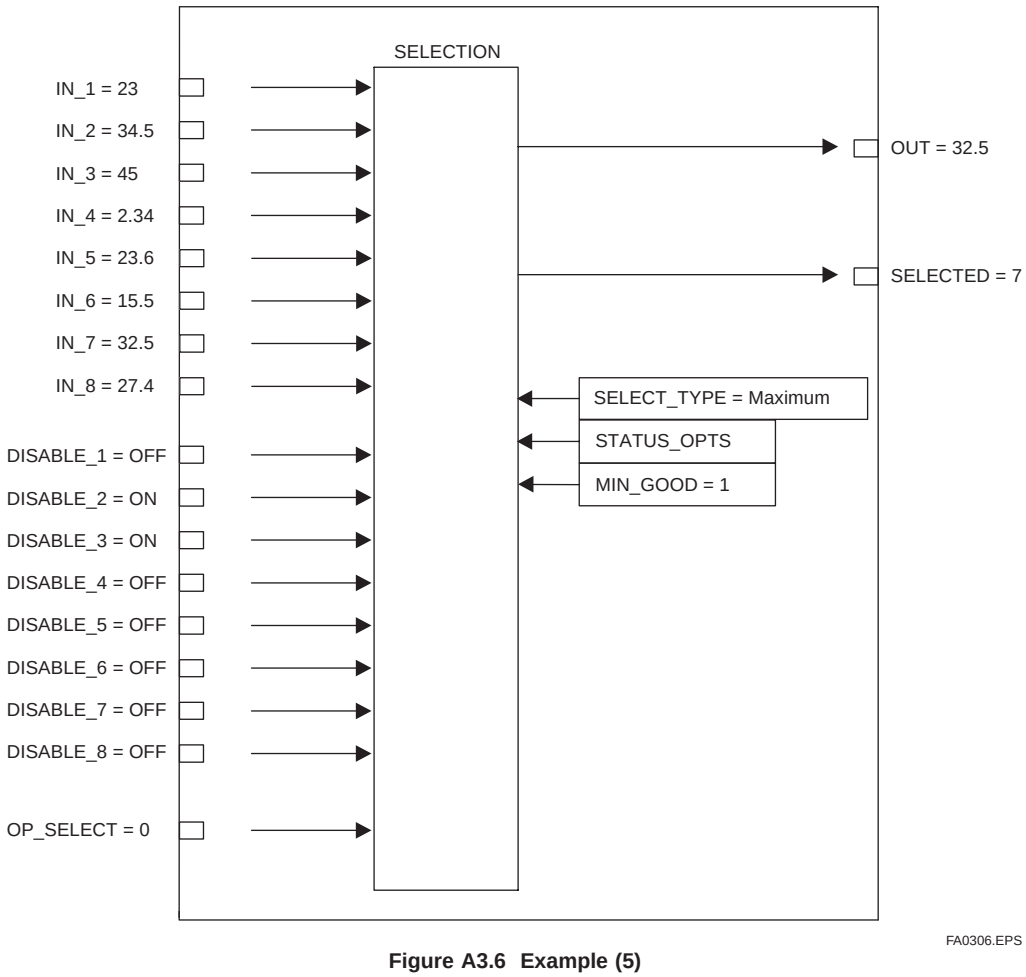

Figure A3.6 Example (5)

Because DISABLE_2 and DISABLE_3 are ON, IN_2 and IN_3 are disabled, and the IN with the maximum value among the remaining IN_n is selected for output. In the above example, since IN_7 has the maximum value among the remaining valid INs, it is output.

When SELECT TYPE is “Middle”

If there is more than one valid input and the number of such input is an odd number, the value of the middle input will be transmitted to OUT. If there is an even number of valid inputs, the average of the middle two inputs is transmitted to OUT. If the average is used for OUT, the block transmits “0” to SELECTED, while it transmits the number of the input used for the middle for other cases. If the number of valid inputs is 1, it is irrelevant to selection by “Middle” selector action. The following shows an example of selection by “Middle” selector action.

If there is an even number of valid inputs:

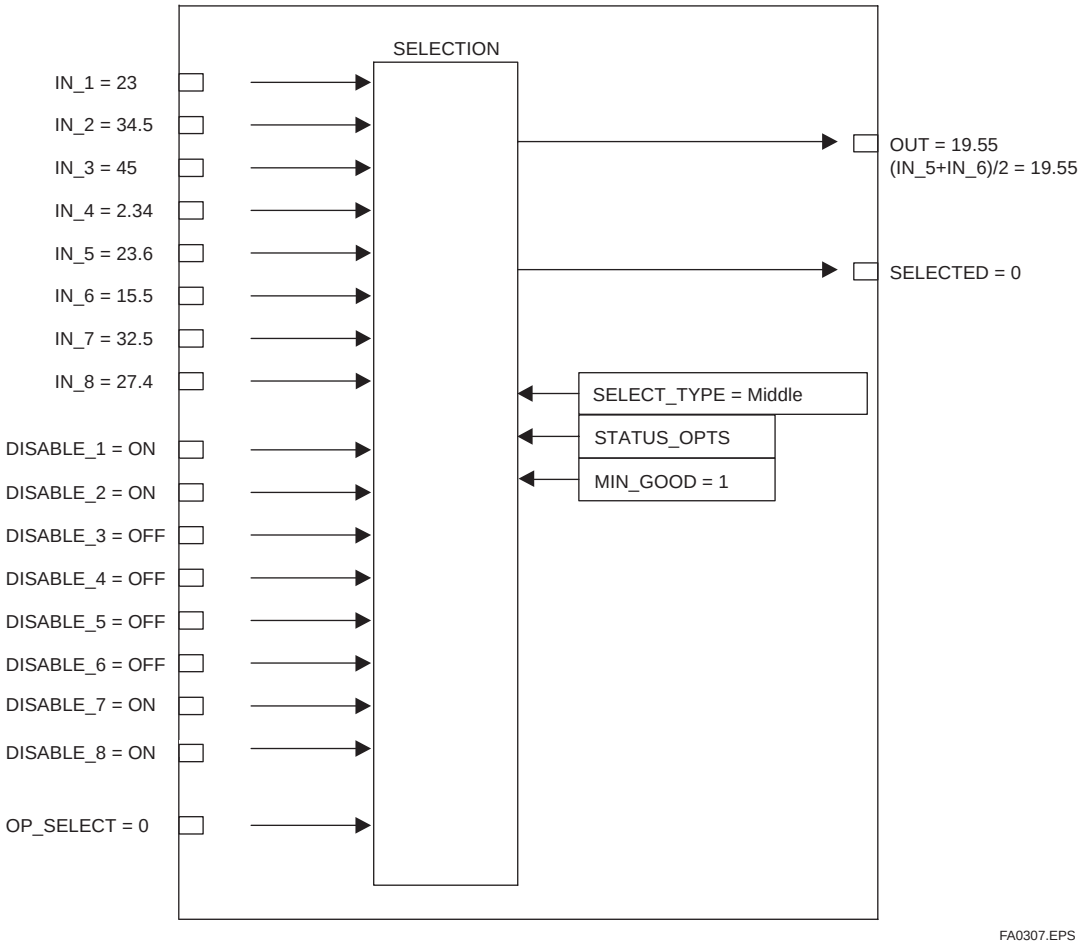

Figure A3.7 Example (6)

Because DISABLE_1, DISABLE_2, DISABLE_7, and DISABLE_8 are ON, the corresponding IN_1, IN_2, IN_7, and IN_8 are disabled and the remaining four INs are enabled. Furthermore, because IN_3 has the maximum value and IN_4 has the minimum value among the valid INs, they are not selected and the average of IN_5 and IN_6 inputs is output. When the average is selected for OUT, SELECTED is set to “0.”

If there is an odd number of valid inputs:

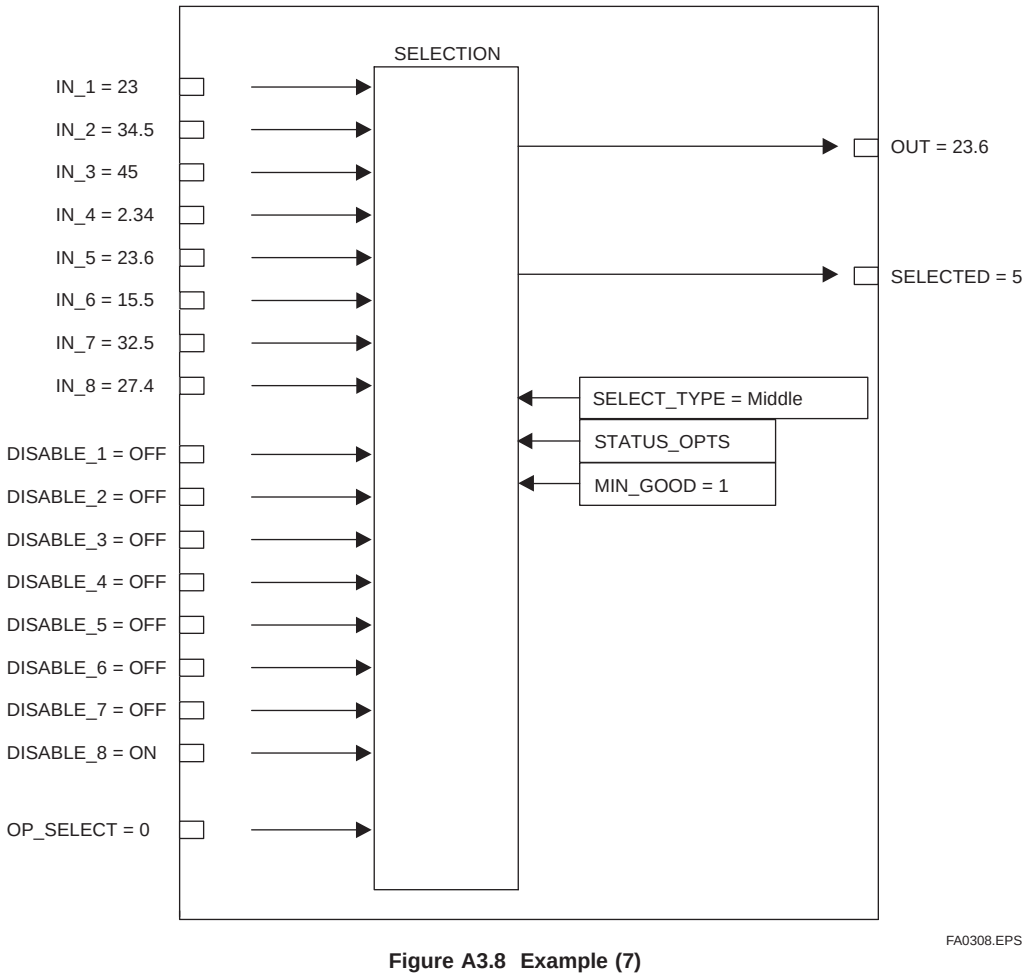

Figure A3.8 Example (7)

If the number of valid INs is an odd multiple, the IN with the middle value will be output. In the above example, the IN_5 input having the middle value is output.

When SELECT TYPE is “Average”

The block calculates the average of the valid inputs and transmits it to OUT. The number of inputs used to calculate its value is indicated in SELECTED.

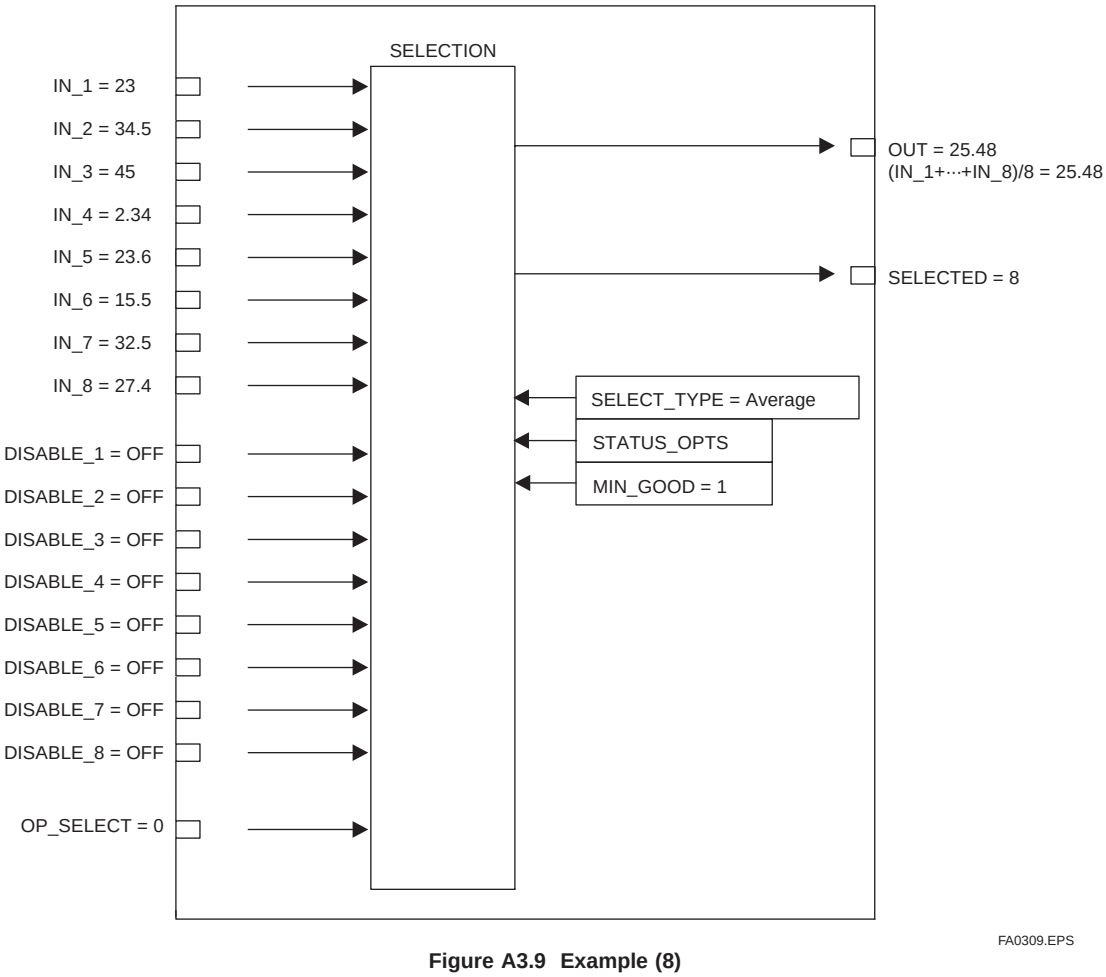

Figure A3.9 Example (8)

When SELECT TYPE is “Latched Good”

The valid input with the smaller input number is selected as an output and is held until it becomes invalid. When it becomes invalid, the next valid input will be selected as an output regardless of the magnitude of the value. Even if an input with the input number smaller than that of the currently selected input recovers, the current selection is held.

Assuming that IN_2 is the valid input with the smallest input number, the order of input selection is IN_2 → IN_3 → ...→ IN_8 → IN_1 → ....

If the power is turned OFF and then ON with SELECT TYPE set to “Latched Good,” input selection starts with the IN that was selected before the power was turned OFF.

A3.4 Output Processing

A3.4.1 Handling of SELECTED

For the value output to SELECTED when OP_SELECT has been selected (that is, not “0”), the number specified by OP_SELECT will be stored as is.

However, “0” is stored in the SELECTED in the following cases:

1. If there is no valid input;
2. If the value of MIN_GOOD is greater than the number of valid inputs;
3. If the input status is “bad” or “uncertain” when the value of OP_SELECT is anything other than “0” (with the exception of the case where the “Uncertain as good” bit in STATUS_OPTS is set.);
4. If the value of OP_SELECT is greater than 8, which is the maximum number of inputs;
5. If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is zero.

As long as there is one valid input, even an invalid input can be selected for OP_SELECT.

If the number of valid inputs is greater than the value of MIN_GOOD, the number of the input (including an invalid input) specified by OP_SELECT will be stored in SELECTED. Therefore, even if an invalid input is selected, SELECTED does not become zero.

If no input is selected for OP_SELECT, the output of SELECTED will depend on SELECT_TYPE.

The Table A3.1 shows the value of SELECTED according to the number of valid inputs and SELECT_TYPE.

Table A3.1 Value of SELECTED According to Inputs

Valid Inputs	Value of SELECTED			
	SELECT_TYPE = First Good	SELECT_TYPE = MINIMUM, MAXIMUM, or Latched Good	SELECT_TYPE = MIDDLE	SELECT_TYPE = AVERAGE
None	0 (zero)	0 (zero)	0 (zero)	0 (zero)
1	# of IN with a smaller value	# of selected IN	# of selected IN	1
Multiple INs (Even # of INs)			0 (the average is taken)	# of valid INs (the average is taken)
Multiple INs (Odd # of INs)			# of IN with the middle value	

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Table A3.2 Value of SELECTED According to the Mode

O/S	MAN	AUTO
0	0	0 to 8

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A3.4.2 OUT Processing

OUT is an output parameter used to send the value selected in the IS block to another function block.

The following describes OUT processing.

Table A3.3 Block Mode and Value

MODE		Value
O/S		· The previous value is output. (At startup, the initial value is used). · Writable (the operator may change the value.)
Man		
Auto	Value specified by MIN_Good > the number of valid inputs	· The previous value is output. · Not writable
	If there is no valid input	
	If the input status is “bad” or “uncertain” when the value of OP_SELECT is anything other than “0” (with the exception of the case where the “Uncertain as good” bit in STATUS_OPTS is set)	
	If the value of OP_SELECT is greater than 8, which is the maximum number of inputs	· Zero · Not writable
	If OP_SELECT is enabled	· The value of the selected input is output. · Not writable
	If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is “0”	· The previous value is output. · Not writable
	If SELECT_TYPE is “First Good”	· The value of a valid input with the smallest input number is output. · Not writable
	If SELECT_TYPE is “MINIMUM”	· The minimum value among the values of the valid inputs is output. · Not writable
	If SELECT_TYPE is “MAXIMUM”	· The maximum value among the values of the valid inputs is output. · Not writable
	If SELECT_TYPE is “MIDDLE” (There is an even multiple number of valid inputs.)	· Because two inputs are positioned in the middle of the values of even multiple valid inputs, the average of the values of these two inputs is output. · Not writable
	If SELECT_TYPE is “MIDDLE” (There is an odd multiple number of valid inputs.)	· The value of the input positioned in the middle of the values of odd multiple valid inputs is output. · Not writable
	If SELECT_TYPE is “AVERAGE”	· The value obtained by dividing the added value of the values of valid inputs by the number of these inputs is output. · Not writable
	If SELECT_TYPE is “Latched Good”	· The value of a valid input with the smallest input number is output. · Not writable

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Table A3.4 Condition and Mode

Condition (Listed in priority sequence)	Mode
If the Actual is in O/S	O/S
If the “Uncertain if Man mode” bit in STATUS_OPTS is set and the Actual is in Man	Man
If the “Uncertain if Man mode” bit in STATUS_OPTS is not set and the Actual is in Man	Man
Values specified by MIN_Good > the number of valid inputs	Auto
If there is no valid input	Auto
If the input status is “bad” or “uncertain” when the value of OP_SELECT is anything other than “0” (with the exception of the case where the “Uncertain as good” bit in STATUS_OPTS is set)	Auto
If the value of OP_SELECT is greater than 8, which is the maximum number of inputs	Auto
If OP_SELECT has selected IN whose status is “bad” or “uncertain” (See the item “Transition of Sub-status in the Case Where OP_SELECT is Selected.”)	Auto
If the value is out of the SELECT_TYPE setting range when the value of OP_SELECT is “0”	Auto

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A3.4.3 STATUS_OPTS

Bit	Description
Use Uncertain as Good	Causes all inputs (OP_SELECT, IN_n, and DISABLE_n) the status of which is "uncertain," to be handled as "good" (NC) status inputs and the others to be handled as "bad" status inputs.
Uncertain if Man mode	When the mode is Man, the status of OUT is interpreted as "uncertain." (This does not apply to SELECTED.)

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A3.5 List of Input Selector Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View 1	View 2	View 3	View 4	Description / Remarks
0	BLOCK_HEADER	Block Tag=O/S		TAG: "IS"					Information relating to this function block, such as block tag, DD revision, and execution time
1	ST_REV		--------	--------	2	2	2	2	Indicates the revision level of the set parameters associated with the IS block. If a setting is modified, this revision is updated. It is used to check for parameter changes, etc.
2	TAG_DESC			Null					A universal parameter that stores comments describing tag information
3	STRATEGY			1				2	A universal parameter intended for use by the high-level system to identify function blocks
4	ALERT_KEY		1-255	1				1	Key information used to identify the location where an alert has occurred. Generally, this parameter is used by the high-level system to identify specific areas in a plant that are under the control of specific operators, to distinguish necessary alarms only. This is one of the universal parameters.
5	MODE_BLK				4		4		A universal parameter representing the operation status of the IS block. It consists of the Actual, Target, Permit, and Normal modes.
6	BLOCK_ERR		--------	--------	2		2		Indicates the error status relating to the Input Selector function block. The bit used by this function block is as follows: Bit 15: O/S mode
7	OUT	MAN		0	5		5		Block output
8	OUT_RANGE					11			Set the range of OUT
9	GRANT_DENY			0		2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before any of them are executed. After the operations are complete, the DENY parameter is checked to find out if any bit corresponding to the relevant operation has been set. If no bit is set, it is evident that the operations have been executed successfully.
10	STATUS_OPTS	O/S	"Use Uncertain as good" and "Uncertain if Manual" only	0				2	A user-selectable option available for status handling in the block
11	IN_1			0	5		5		Input 1
12	IN_2			0	5		5		Input 2
13	IN_3			0	5		5		Input 3
14	IN_4			0	5		5		Input 4
15	DISABLE_1		0,1	0	2		2		Selector switch to disable input 1 from being selected
16	DISABLE_2		0,1	0	2		2		Selector switch to disable input 2 from being selected
17	DISABLE_3		0,1	0	2		2		Selector switch to disable input 3 from being selected
18	DISABLE_4		0,1	0	2		2		Selector switch to disable input 4 from being selected
19	SELECT_TYPE		1-6	0				1	Specifies the input selection algorithm.
20	MIN_GOOD		0-8	0				1	Parameter specifying the minimum required number of inputs with "good" status If the number of inputs with "good" status is less than the value of MIN_GOOD, input selection is canceled.
21	SELECTED		0-8	0	2		2		Indicates the number of the selected input. However, it indicates the number of inputs used to calculate the average if SELECT_TYPE = Average. If no input is selectable or if there are multiple inputs, it becomes "0" (none).
22	OP_SELECT		0-8	0	2		2		A parameter to forcibly employ the input of a selected number (Operator-settable)
23	UPDATE_EVT		--------	--------					Indicates event information if an update event (setting change) occurs.
24	BLOCK_ALM		--------	--------					Indicates alarm information if a block alarm occurs.
25	IN_5			0	5		5		Input 5
26	IN_6			0	5		5		Input 6
27	IN_7			0	5		5		Input 7
28	IN_8			0	5		5		Input 8
29	DISABLE_5		0,1	0	2		2		Selector switch to disable input 5 from being selected
30	DISABLE_6		0,1	0	2		2		Selector switch to disable input 6 from being selected
31	DISABLE_7		0,1	0	2		2		Selector switch to disable input 7 from being selected
32	DISABLE_8		0,1	0	2		2		Selector switch to disable input 8 from being selected

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A3.6 Application Example

The following describes the temperature control system of a fixed bed-type reactor. In this case, there are instances where the point showing the maximum temperature changes due to catalytic deterioration, raw material flow, etc. Therefore, a large number of measurement points are provided, and the maximum value obtained among these measurement points is input to the controller to control reactor temperature.

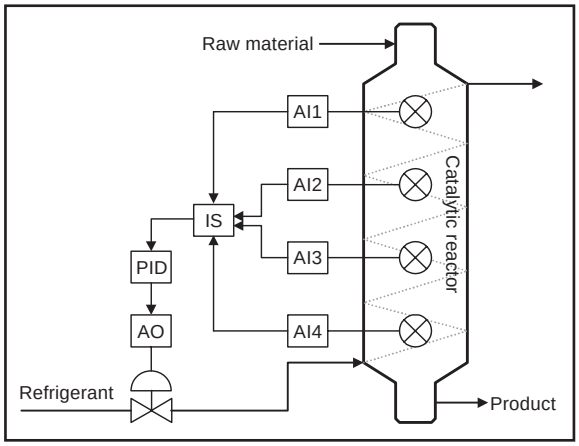

Figure A3.10 Temperature Control System of a Fixed Bed-type Reactor

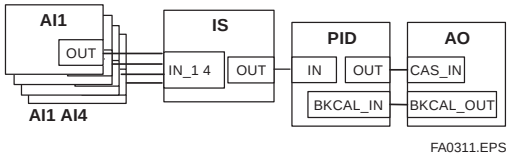

Figure A3.11 Example of Scheduling

AI1 : Temperature 1, AI2: Temperature 2, AI3: Temperature 3, AI4: Temperature 4
IS : SELECT_TYPE = MAX

Basic operations and work sequence:

1. The IS block obtains values and status information from AI.
2. The block selects the AI information using the alternatives.
3. The block displays and outputs the information selected by SELECTED.

APPENDIX 4. ARITHMETIC (AR) BLOCK

The Arithmetic (AR) block switches two main inputs of different measurement ranges seamlessly and combines the result with three auxiliary inputs through the selected compensation function (10 types) to calculate the output.

A4.1 Arithmetic Function Block Schematic

The diagram below shows the Arithmetic block schematic.

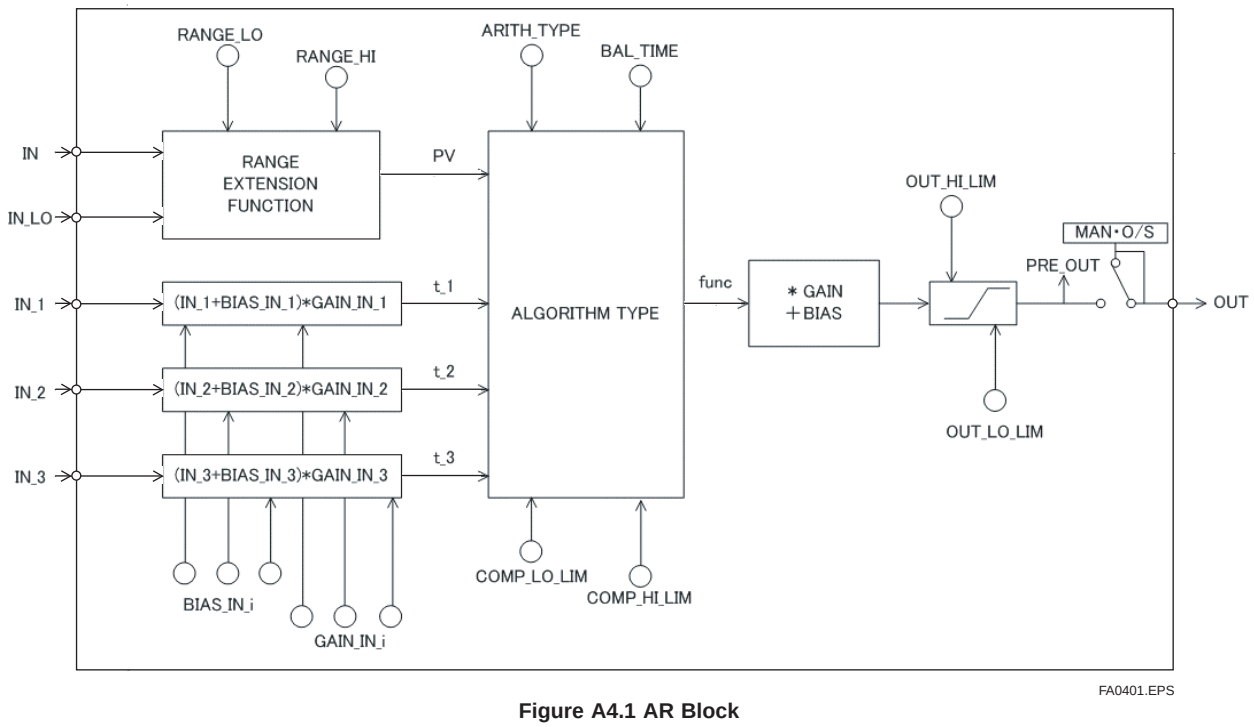

Figure A4.1 AR Block

The Arithmetic block is divided into three sections:

- Input section: Makes a go/no-go decision on the use of an input value, switches the range, and determines the PV status.
- Computation section: Makes calculations through ARITH_TYPE.
- Output section: Applies gain multiplication and bias addition to the calculated result to perform limitation processing for output.

* The range extension function compensates the IN and IN_LO input values when two devices with different ranges are connected, to make smooth input switching.

A4.2 Input Section

There are five inputs: IN and IN_LO main inputs and IN_1, IN_2, and IN_3 auxiliary inputs.

IN and IN_LO are intended to connect devices with different measurement ranges and allow the use of switching a measurement range by selecting the measuring device. However, because there are slight differences between IN and IN_LO values even when the same item is measured, instantaneous switching causes abrupt changes in the output.

To prevent this phenomenon, the Arithmetic block uses a function known as range extension to compensate the IN and IN_LO values between RANGE_HI and RANGE_LO. This enables the input to be switched smoothly. The result of the range extension function is substituted into PV to be used for calculations.

A4.2.1 Main Inputs

The range extension function determines the PV value in the following order:

1. If IN ≧ RANGE_HI → PV = IN
2. If IN ≦ RANGE_LO → PV = IN_LO
3. If RANGE_HI > IN > RANGE_LO → PV = g × IN + (1- g) × IN_LO

g = (IN - RANGE_LO) / (RANGE_HI - RANGE_LO)

RANGE_HI and RANGE_LO are threshold values for switching two main inputs seamlessly.

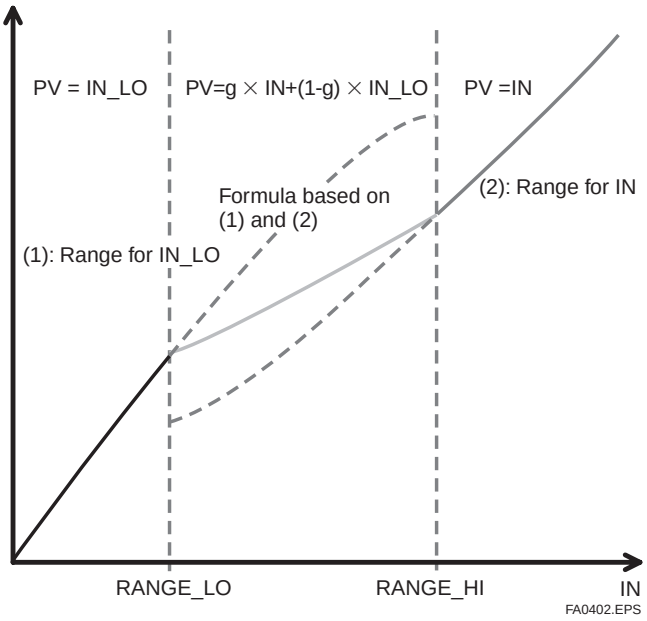

Figure A4.2 Range Extension Function and PV

PV is a parameter with status information, and PV status is determined by the value of "g."

If "g" < 0.5 → The status of IN_LO is used.

If "g" ≧ 0.5 → The status of IN is used.

Determination of the status is made with a hysteresis of 10% provided for 0.5.

If RANGE_LO > RANGE_HI, the statuses of PV and OUT are "Bad. Configuration Error." Then "Configuration Error" is output to BLOCK_ERR.

If there is only one main input, the input is incorporated into the computation section as is, not taking into account RANGE_HI and RANGE_LO.

Example:

Assuming that

RANGE_LO	20
RANGE_HI	300

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the following are established:

IN = 310, IN_LO = 20 → PV = 310

IN = 230, IN_LO = 20 → g = (230 - 20) / (300 - 20) = 0.75

PV = 0.75 × 230 + (1 - 0.75) × 20 = 177.5

IN = 90, IN_LO = 20 → g = (90 - 20) / (300 - 20) = 0.25

PV = 0.25 × 230 + (1 + 0.25) × 20 = 37.5

IN = 19, IN_LO = 10 → PV = 10

A4.2.2 Auxiliary Inputs

There are bias and gain parameters for the IN_1, IN_2, and IN_3 auxiliary inputs. The following shows the equation using them.

$$t\_i = (IN\_i + BIAS\_IN\_i) \times GAIN\_IN\_i$$

The bias parameter is used for calculating absolute temperature or absolute pressure, while the gain parameter is used for normalization of square root extraction.

A4.2.3 INPUT_OPTS

INPUT_OPTS has an option that handles an input with "uncertain" or "bad" status as a "good" status input.

Bit	Function
0	Handles IN as a "good" status input if its status is "uncertain."
1	Handles IN_LO as a "good" status input if its status is "uncertain."
2	Handles IN_1 as a "good" status input if its status is "uncertain."
3	Handles IN_1 as a "good" status input if its status is "bad."
4	Handles IN_2 as a "good" status input if its status is "uncertain."
5	Handles IN_2 as a "good" status input if its status is "bad."
6	Handles IN_3 as a "good" status input if its status is "uncertain."
7	Handles IN_3 as a "good" status input if its status is "bad."
8 to 15	Reserved

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There are options called "IN Use uncertain" and "IN_LO Use uncertain" for the IN and IN_LO inputs. When these options are valid, IN and IN_LO are internally interpreted as "good" IN and IN_LO even if their statuses are "uncertain." (There is no option for "bad" status.)

For the IN_1, IN_2, and IN_3 auxiliary inputs, there are options known as "IN_i Use uncertain" and "IN_i Use bad." If these options are valid, an IN_i with "uncertain" or "bad" status is internally interpreted as a "good" IN_i.

* The exception is that if the input status is "Bad. Not Connected," INPUT_OPTS does not apply and the input is considered "bad" as is.

A4.2.4 Relationship between the Main Inputs and PV

The value and PV status are determined by the statuses of two main inputs, INPUT_OPTS, and RANGE_LO and RANGE_HI.

· If the statuses of two main inputs are both "good" or anything other than "good"
See A4.2.1, Main Inputs.

· If only one of two main inputs has "good" status after application of INPUT_OPTS, the PV value is determined as follows:

  · If the status of IN is "good" and that of "IN_LO" is anything other than "good"

    IN > RANGE_LO → PV = IN

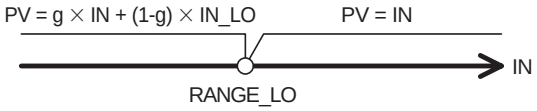
    IN ≦ RANGE_LO → See A4.2.1.

  · If the status of IN is anything other than "good" and that of "IN_LO" is "good"

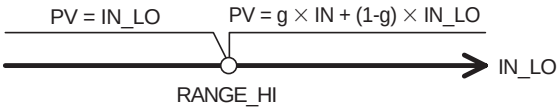
    IN_LO < RANGE_HI → PV = IN_LO

    IN_LO ≧ RANGE_HI → See A4.2.1.

If the status of IN is "good" and that of "IN_LO" is anything other than "good"



If the status of IN is anything other than "good" and that of "IN_LO" is "good"



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A4.3 Computation Section

A4.3.1 Computing Equations

This subsection shows computing equations used in the computation section:

1) Flow compensation (linear)

func = PV × f

f = (t_1 / t_2)

2) Flow compensation (square root)

func = PV × f

f = sqrt(t_1 / t_2 / t_3)

3) Flow compensation (approximate expression)

func = PV × f

f = sqrt(t_1 × t_2 × t_3 × t_3)

4) Quantity of heat calculation

func = PV × f

f = (t_1 - t_2)

5) Multiplication and division

func = PV × f

f = ((t_1 / t_2) + t_3)

6) Average calculation

func = (PV + t_1 + t_2 + t_3) / N

where N: number of inputs

7) Summation

func = PV + t_1 + t_2 + t_3

8) Polynomial computation

func = PV + t_1^2 + t_2^3 + t_3^4

9) HTG-level compensation

func = (PV - t_1) / (PV - t_2)

10) Polynomial computation

func = PV + t_1 × PV^2 + t_2 × PV^3 + t_3 × PV^4

* Precaution for computation

Division by "0": If a value is divided by "0," the calculation result is interpreted as 10^{37} and, depending with core, a plus sign is added to it.

Negative square root: The square root of an absolute value is extracted and a minus sign is added to it.

A4.3.2 Compensated Values

In computing equations 1) to 5) in A4.3.1, the value "f" is restricted by the COMP_HI_LIM or COMP_LO_LIM parameter. In this case, the value "f" is treated as follows:

If "f" > COMP_HI_LIM,

f = COMP_HI_LIM

If "f" < COMP_LO_LIM,

f = COMP_LO_LIM

A4.3.3 Average Calculation

In computing equation 6) in A4.3.1, the average of input value is calculated. Here, it is necessary to obtain the number of inputs, N. For this, determination is made to see if the sub-status of each input is "Not Connected." Note that the main inputs may be accepted if IN or IN_LO is not in "Not Connected" sub-status. In this case, the number of inputs that are not in "Not Connected" sub-status is regarded as "N."

A4.4 Output Section

After executing the computing equation, the block applies a gain to the calculated result and then adds a bias to it.

It then substitutes the result into PRE_OUT and if the mode is in AUTO, the value of PRE_OUT is taken as OUT.

PRE_OUT = func × gain + bias

where func: result of computing equation execution

OUT = PRE_OUT (when the mode is in AUTO)

Next, the block performs limitation processing (OUT_HI_LIM, OUT_LOW_LIM). This processing is described as follows with respect to the value of PRE_OUT.

If PRE_OUT > OUT_HI_LIM:

PRE_OUT = OUT_HI_LIM

The "high limited" processing is applied to the status of PRE_OUT.

If PRE_OUT < OUT_LO_LIM:

PRE_OUT = OUT_LO_LIM

The "low limited" processing is applied to the status of PRE_OUT.

A4.4.1 Mode Handling

Mode	Output
Auto	OUT = PRE_OUT
MAN	For OUT, the OUT value in the Auto mode just before change to MAN or O/S is retained.
O/S	

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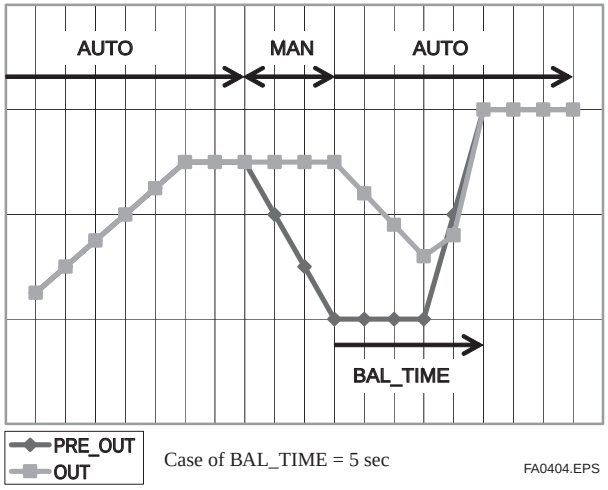
In the Manual mode (including O/S), the value of OUT in the Auto mode just before a change to the Manual mode is held or the value written to OUT is output.

If the mode is switched from Manual to Auto, the value of OUT that is linearly changed with respect to the value of PRE_OUT for time set by BAL_TIME is output. The PRE_OUT always indicates the results of calculation. After elapse of BAL_TIME, OUT = PRE_OUT is established. Note that if the value of BAL_TIME is changed during linear change of the OUT value, it is not reflected. The value of BAL_TIME will be reflected only after the mode is changed the next time.



Case of BAL_TIME = 5 sec

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The value of OUT is represented by the following equation.

$$yn = yn\text{-}1 + (xn - yn\text{-}1) / (\alpha - n)$$

$$\alpha = (T / tc) + 1$$

*: The value of T/tc truncates digits to the right of the decimal point.

where y: OUT

x: PRE_OUT

tc: period of execution

T: BAL_TIME

n: period

A4.4.2 Status Handling

The setting of INPUT_OPTS is applied to the input status. When INPUT_OPTS is applied, there are cases where the PV status becomes “good” even if the status of main inputs is “uncertain” or the status of auxiliary inputs is “uncertain” or “bad.”

The PV status is classified by the following:

· If the statuses of two main inputs are both “good” or anything other than “good”:

See A4.2.1, Main Inputs.

· If only one of the statuses of two main inputs is “good”:

· If the status of IN is “good” and that of “IN_LO” is anything other than “good”

IN > RANGE_LO → The status of IN applies.

IN ≦ RANGE_LO → See A4.2.1, Main Inputs

· If the status of IN is anything other than “good” and that of “IN_LO” is “good”

IN_LO < RANGE_HI → The status of IN_LO applies.

IN_LO ≧ RANGE_HI → See A4.2.1, Main Inputs

The exception is that if RANGE_LO > RANGE_HI, the PV status is made “Bad. Configuration Error.”

The input status irrelevant to the computing equation selected by ARITH_TYPE will be ignored and does not affect other statuses. The statuses of outputs (OUT.Status and PRE_OUT.Status) are interpreted as the status of the worst input among the statuses of PV and auxiliary inputs (IN_1, IN_2, and IN_3) to which INPUT_OPTS has been applied.

Example:

		Case 1	Case 2	Case 3
PV		Good		
IN_1		Uncertain		
IN_2		Bad		
IN_3		Bad		
INPUT_OPTS	IN_1	Handled as a “good” input if its status is “uncertain.”	No option	
	IN_2	Handled as a “good” input if its status is “bad.”		No option
	IN_3	No option		
ARITH_TYPE		1) Flow compensation (linear) in A4.3.1, “Computing Equations”		
OUT.Status		Good	Uncertain	Bad

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A4.5 List of the Arithmetic Block Parameters

Relative Index	Parameter	Write Mode	Valid Range	Initial Value	View 1	View 2	View 3	View 4	Description / Remarks
0	BLOCK_HEADER	O/S		TAG="AR"					Information relating to this function block, such as block tag, DD revision, and execution time
1	ST_REV			0	2	2	2	2	Indicates the revision level of the set parameters associated with the Arithmetic block. If a setting is modified, this revision is updated. It is used to check for parameter changes, etc.
2	TAG_DESC			Null					A universal parameter that stores comments describing tag information
3	STRATEGY			1				2	A universal parameter intended for use by a high-level system to identify function blocks
4	ALERT_KEY		1-255	1				1	Key information used to identify the location at which an alert has occurred. Generally, this parameter is used by a high-level system to identify specific areas in a plant that are under the control of specific operators, to separate necessary alerts only. This is one of the universal parameters.
5	MODE_BLK			AUTO	4		4		A universal parameter representing the operation status of the Arithmetic block. It consists of the Actual, Target, Permit, and Normal modes.
6	BLOCK_ERR			0	2		2		Indicates the error status relating to the Arithmetic block. The bit used by this function block is as follows: Bit 1: Block Configuration Error Bit 15: O/S mode
7	PV			0	5		5		The result of a range extension function is substituted into this. When viewed from the computing equation, PV is the main input.
8	OUT	MAN		0	5		5		Block output
9	PRE_OUT			0	5		5		Always indicates the calculation result. The value is substituted into OUT in Auto mode.
10	PV_SCALE	O/S				11			Indicates PV scaling (for making a memo).
11	OUT_RANGE					11			Output scaling for the host (for making a memo)
12	GRANT_DENY			0		2			The parameter used to check if various operations have been executed. The bits in the GRANT parameter corresponding to various operations are set before any of them are executed. After the operations are completed, the DENY parameter is checked to find out if any bit corresponding to the relevant operation has been set. If no bit has been set, it is evident that the operations have been executed successfully.
13	INPUT_OPTS			0				2	Determines whether an input is used as a "good" input when the input status is "bad" or "uncertain."
14	IN			0			5		Input block
15	IN_LO			0			5		Input for a low-range transmitter. This is used for the range extension function.
16	IN_1			0			5		Auxiliary input 1
17	IN_2			0			5		Auxiliary input 2
18	IN_3			0			5		Auxiliary input 3
19	RANGE_HI			0				4	High limit for switching to a high-range transmitter by the range extension function.
20	RANGE_LO			0				4	Low limit for switching to a low-range transmitter by the range extension function.
21	BIAS_IN_1			0				4	IN_1 bias
22	GAIN_IN_1			0				4	IN_1 gain
23	BIAS_IN_2			0				4	IN_2 bias
24	GAIN_IN_2			0				4	IN_2 gain
25	BIAS_IN_3			0				4	IN_3 bias
26	GAIN_IN_3			0				4	IN_3 gain
27	COMP_HI_LIM			+INF				4	High limit of compensation factor f
28	COMP_LO_LIM			-INF				4	Low limit of compensation factor f

Bit	Function
0	Handles IN as "good" input if its status is "uncertain."
1	Handles IN_LO as "good" input if its status is "uncertain."
2	Handles IN_1 as "good" input if its status is "uncertain."
3	Handles IN_1 as "good" input if its status is "bad."
4	Handles IN_2 as "good" input if its status is "uncertain."
5	Handles IN_2 as "good" input if its status is "bad."
6	Handles IN_3 as "good" input if its status is "uncertain."
7	Handles IN_3 as "good" input if its status is "bad."
8 to 15	Reserved

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<table>
<tr><th rowspan="2">Relative Index</th><th rowspan="2">Parameter</th><th rowspan="2">Write Mode</th><th rowspan="2">Valid Range</th><th rowspan="2">Initial Value</th><th colspan="4">View</th><th rowspan="2">Description / Remarks</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>29</td><td>ARITH_TYPE</td><td>1 to 10</td><td></td><td>0x01</td><td></td><td></td><td></td><td>1</td><td>Computation algorithm identification no.
<table>
<tr><th>Value</th><th>Selection Name</th><th>Description</th></tr>
<tr><td>1</td><td>Flow compensation, linear</td><td>Flow compensation (linear)</td></tr>
<tr><td>2</td><td>Flow compensation, square root</td><td>Flow compensation (square root)</td></tr>
<tr><td>3</td><td>Flow compensation, approximate</td><td>Flow compensation (approximate expression)</td></tr>
<tr><td>4</td><td>BTU flow (*)</td><td>Quantity of heat calculation</td></tr>
<tr><td>5</td><td>Traditional Multiply Divide</td><td>Multiplication and division</td></tr>
<tr><td>6</td><td>Average</td><td>Average calculation</td></tr>
<tr><td>7</td><td>Traditional summer</td><td>Summation</td></tr>
<tr><td>8</td><td>Fourth order Polynomial, Type 1</td><td>4th-order (auxiliary input) polynomial computation</td></tr>
<tr><td>9</td><td>HTG level compensation (*)</td><td>HTG-level compensation</td></tr>
<tr><td>10</td><td>Fourth order Polynomial, Type 2</td><td>4th-order (main input) polynomial computation</td></tr>
</table>
* BTU stands for British thermal unit.
HTG stands for hydrostatic tank gauging.</td></tr>
<tr><td>30</td><td>BAL_TIME</td><td>More than 0</td><td></td><td>0</td><td></td><td></td><td></td><td>4</td><td>Time taken to return to the set value</td></tr>
<tr><td>31</td><td>BIAS</td><td></td><td></td><td>0</td><td></td><td></td><td></td><td>4</td><td>Bias value used to calculate the output</td></tr>
<tr><td>32</td><td>GAIN</td><td></td><td></td><td>1</td><td></td><td></td><td></td><td>4</td><td>Gain value used to calculate the output</td></tr>
<tr><td>33</td><td>OUT_HI_LIM</td><td></td><td></td><td>+INF</td><td></td><td></td><td></td><td>4</td><td>Maximum output value</td></tr>
<tr><td>34</td><td>OUT_LO_LIM</td><td></td><td></td><td>-INF</td><td></td><td></td><td></td><td>4</td><td>Minimum output value</td></tr>
<tr><td>35</td><td>UPDATE_EVT</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Indicates event information if an update event (setting change) occurs.</td></tr>
<tr><td>36</td><td>BLOCK_ALM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Indicates alarm information if a block alarm occurs.</td></tr>
</table>

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APPENDIX 5. PID BLOCK

A PID block performs the PID control computation based on the deviation of the measured value (PV) from the setpoint (SV), and is generally used for constant-setpoint and cascaded-setpoint control.

A5.1 Function Diagram

The figure below depicts the function diagram of a PID block.

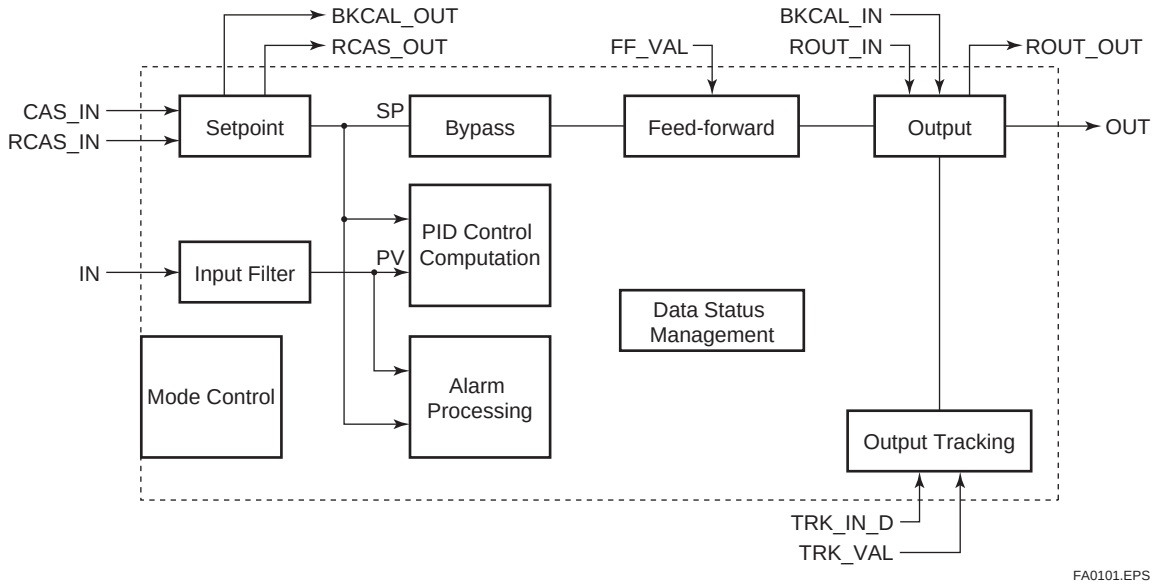

Figure A5.1 PID Block

A5.2 Functions of PID Block

The table below shows the functions provided in a PID block.

Function	Description
PID control computation	Computes the control output in accordance with the PID control algorithm.
Control output	Converts the change in control output ΔMV to the manipulated value MV that is to be actually output.
Switching of direction of control action	Switches over the direction of control action between direct and reverse, i.e., the direction of changes in the control output depending on the changes in the deviation.
Control action bypass	When the bypass is on, the value of the SP is scaled to the range of the OUT and output as the OUT.
Feed-forward	Adds the value of the FF_VAL (input to the PID block) to the output from the PID computation.
Measured-value tracking	Equalizes the setpoint SP to the measured value PV.
Setpoint limiters	Limit the value of setpoint SP within the preset upper and lower levels as well as limit the rate of change when the PID block is in Auto mode.
External-output tracking	Performs the scaling of the value of TRK_VAL to the range of the OUT and outputs it as the OUT.
Mode change	Changes the block mode between 8 modes: O/S, IMan, LO, Man, Auto, Cas, RCas, ROut.
Bumpless transfer	Prevents a sudden change in the control output OUT at changes in block mode and at switching of the connection from the control output OUT to the cascaded secondary function block.
Initialization and manual fallback	Changes the block mode to IMan and suspends the control action when the specified condition is met.
Manual fallback	Changes the block mode to Man and aborts the control action.
Auto fallback	Changes the block mode to Auto when it is Cas, and continues the control action with the setpoint set by the operator.
Mode shedding upon computer failure	Changes the block mode in accordance with the SHED_OPT setting upon a computer failure.
Alarm processing	Generates block alarms and process alarms, and performs event updates.

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A5.3 Parameters of PID Block

NOTE: In the table below, the Write column shows the modes in which the respective parameters can be written. A blank in the Write column indicates that the corresponding parameter can be written in all modes of the PID block. A dash (-) indicates that the corresponding parameter cannot be written in any mode.

Index	Parameter Name	Default (factory setting)	Write	Valid Range	Description
0	Block Header	TAG: "PID"	Block Tag = O/S		Same as that for an AI block.
1	ST_REV		—		Same as that for an AI block.
2	TAG_DESC	Null			Same as that for an AI block.
3	STRATEGY	1			Same as that for an AI block.
4	ALERT_KEY	1		1 to 255	Same as that for an AI block.
5	MODE_BLK				
6	BLOCK_ERR		—		Same as that for an AI block.
7	PV		—		Measured value; the non-dimensional value that is converted from the input (IN) value based on the PV_SCALE values and filtered.
8	SP	0	AUTO	PV_SCALE ±10%	Setpoint
9	OUT		MAN		Output
10	PV_SCALE	100 0 1133 1	O/S		Upper and lower scale limit values used for scaling of the input (IN) value.
11	OUT_SCALE	100 0 1342 1	O/S		Upper and lower scale limit values used for scaling of the control output (OUT) value to the values in the engineering unit.
12	GRANT_DENY	0	AUTO		Same as that for an AI block.
13	CONTROL_OPTS	0	O/S		Setting for control action. See Section A5.13 for details.
14	STATUS_OPTS	0	O/S		See Section A5.15 for details.
15	IN	0			Controlled-value input
16	PV_FTIME	2	AUTO	Non-negative	Time constant (in seconds) of the first-order lag filter applied to IN
17	BYPASS	1 (off)	MAN	1, 2	Whether to bypass the control computation. 1 (off): Do not bypass. 2 (on): Bypass.
18	CAS_IN	0			Cascade setpoint
19	SP_RATE_DN	+INF		Positive	Rate-of-decrease limit for setpoint (SP)
20	SP_RATE_UP	-INF		Positive	Rate-of-increase limit for setpoint (SP)
21	SP_HI_LIM	100		PV_SCALE ±10%	Upper limit for setpoint (SP)
22	SP_LO_LIM	0		PV_SCALE ±10%	Lower limit for setpoint (SP)
23	GAIN	1			Proportional gain (= 100 / proportional band)
24	RESET	10			Integration time (seconds)
25	BAL_TIME	0		Positive	Unused
26	RATE	0		Positive	Derivative time (seconds)
27	BKCAL_IN	0			Read-back of control output
28	OUT_HI_LIM	100		OUT_SCALE ±10%	Upper limit for control output (OUT)
29	OUT_LO_LIM	0		OUT_SCALE ±10%	Lower limit for control output (OUT)
30	BKCAL_HYS	0.5 (%)		0 to 50%	Hysteresis for release from a limit for OUT.status
31	BKCAL_OUT	0	—		Read-back value to be sent to the BKCAL_IN in the upper block
32	RCAS_IN	0			Remote setpoint set from a computer, etc.
33	ROUT_IN	0			Remote control output value set from a computer, etc.

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Index	Parameter Name	Default (factory setting)	Write	Valid Range	Description
34	SHED_OPT	0			Action to be performed in the event of mode shedding. SHED_OPT defines the changes to be made to MODE.BLK.target and MODE.BLK.actual when the value of RCAS_IN.status or ROUT_IN.status becomes Bad if .MODE_BLK.actual = RCas or ROut. See Section A5.17.1 for details.
35	RCAS_OUT	0	—		Remote setpoint sent to a computer, etc.
36	ROUT_OUT	0	—		Remote control output value
37	TRK_SCALE	100 0 1342 1	MAN		Upper and lower scale limits used to convert the output tracking value (TRK_VAL) to non-dimensional.
38	TRK_IN_D	0			Switch for output tracking. See Section A5.12 for details.
39	TRK_VAL	0			Output tracking value (TRK_VAL) When MODE_BLK.actual = LO, the value scaled from the TRK_VAL value is set in OUT.
40	FF_VAL	0			Feedforward input value. The FF_VAL value is scaled to a value with the same scale as for OUT, multiplied by the FF_GAIN value, and then added to the output of the PID computation.
41	FF_SCALE	100 0 1342 1	MAN		Scale limits used for converting the FF_VAL value to a non-dimensional value.
42	FF_GAIN	0	MAN		Gain for FF_VAL
43	UPDATE_EVT		—		Same as that for an AI block.
44	BLOCK_ALM		—		Same as that for an AI block.
45	ALARM_SUM	Enable			Same as that for an AI block.
46	ACK_OPTION	0xFFFF			Same as that for an AI block.
47	ALARM_HYS	0.5%		0 to 50%	Hysteresis for alarm detection and resetting to prevent each alarm from occurring and recovering repeatedly within a short time.
48	HI_HI_PRI	0		0 to 15	Priority order of HI_HI_ALM alarm
49	HI_HI_LIM	+INF		PV_SCALE	Setting for HI_HI_ALM alarm
50	HI_PRI	0		0 to 15	Priority order of HI_ALM alarm
51	HI_LIM	+INF		PV_SCALE	Setting for HI_ALM alarm
52	LO_PRI	0		0 to 15	Priority order of LO_ALM alarm
53	LO_LIM	-INF		PV_SCALE	Setting for LO_ALM alarm
54	LO_LO_PRI	0		0 to 15	Priority order of LO_LO_ALM alarm
55	LO_LO_LIM	-INF		PV_SCALE	Setting for LO_LO_ALM alarm
56	DV_HI_PRI	0		0 to 15	Priority order of DV_HI_ALM alarm
57	DV_HI_LIM	+INF			Setting for DV_HI_ALM alarm
58	DV_LO_PRI	0		0 to 15	Priority order of DV_LO_ALM alarm
59	DV_LO_LIM	-INF			Setting for DV_LO_ALM alarm
60	HI_HI_ALM	—	—		Alarm that is generated when the PV value has exceeded the HI_HI_LIM value and whose priority order* is defined in HI_HI_PRI. * Priority order: Only one alarm is generated at a time. When two or more alarms occur at the same time, the alarm having the highest priority order is generated. When the PV value has decreased below [HI_HI_LIM - ALM_HYS], HI_HI_ALM is reset.
61	HI_ALM	—	—		As above
62	LO_ALM	—	—		As above Reset when the PV value has increased above [LO_LIM + ALM_HYS].
63	LO_LO_ALM	—	—		As above
64	DV_HI_ALM	—	—		Alarm that is generated when the value of [PV - SP] has exceeded the DV_HI_LIM value. Other features are the same as HI_HI_ALM.
65	DV_LO_ALM	—	—		Alarm that is generated when the value of [PV - SP] has decreased below the DV_LO_LIM value. Other features are the same as LO_LO_ALM.

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A5.4 PID Computation Details

A5.4.1 PV-proportional and -derivative Type PID (I-PD) Control Algorithm

For PID control, the PID block employs the PV-proportional and PV-derivative type PID control algorithm (referred to as the I-PD control algorithm) in Auto and RCas mode. The I-PD control algorithm ensures control stability against sudden changes in the setpoint, such as when the user enters a new setpoint value. At the same time, the I-PD algorithm ensures excellent controllability by performing proportional, integral, and derivative control actions in response to changes of characteristics in the controlled process, changes in load, and occurrences of disturbances.

In Cas mode, PV derivative type PID control algorithm (referred to as the PI-D control algorithm) is employed in order to obtain better performance against the changes in the setpoint. The algorithm is automatically switched by the block according to the mode. A basic form of each algorithm is expressed in the equation below.

I-PD Control Algorithm (in Auto / RCas mode)

$$\Delta MVn = K\left\{\Delta PVn + \frac{\Delta T}{Ti}(PVn - SPn) + \frac{Td}{\Delta T}\Delta(\Delta PVn)\right\}$$

PI-D Control Algorithm (in Cas mode)

$$\Delta MVn = K\left\{\Delta(PVn - SPn) + \frac{\Delta T}{Ti}(PVn - SPn) + \frac{Td}{\Delta T}\Delta(\Delta PVn)\right\}$$

Where,

- ΔMVn = change in control output
- ΔPVn = change in measured (controlled) value = $PVn - PVn_{-1}$
- ΔT = control period = period_of_execution in Block Header
- K = proportional gain = GAIN (= 100/ proportional band)
- Ti = integral time = RESET
- Td = derivative time = RATE

The subscripts, n and n_{-1}, represent the time of sampling such that PVn and PVn_{-1} denote the PV value sampled most recently and the PV value sampled at the preceding control period, respectively.

A5.4.2 PID Control Parameters

The table below shows the PID control parameters.

Parameter	Description	Valid Range
GAIN	Proportional gain	0.05 to 20
RESET	Integral time	0.1 to 10,000 (seconds)
RATE	Derivative time	0 to infinity (seconds)

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A5.5 Control Output

The final control output value, OUT, is computed based on the change in control output ΔMVn, which is calculated at each control period in accordance with the aforementioned algorithm. The PID block in an EJX performs the velocity type output action for the control output.

A5.5.1 Velocity Type Output Action

The PID block determines the value of the new control output OUT by adding the change in control output calculated in the current control period, ΔMVn, to the current read-back value of the MV, MV_{RB} (BKCAL_IN). This action can be expressed as:

ΔMVn' = ΔMVn ∗ (OUT_SCALE. EU100 − OUT_SCALE. EU_0) / (PV_SCALE. EU_100 − PV_SCALE. EU_0)

(Direct Acting is False in CONTROL_OPTS)
OUT = BKCAL_IN − ΔMVn'
(Direct Acting is True in CONTROL_OPTS)
OUT = BKCAL_IN + ΔMVn'

A5.6 Direction of Control Action

The direction of the control action is determined by the Direct Acting setting in CONTROL_OPTS.

Value of Direct Acting	Resulting Action
True	The output increases when the input PV is greater than the setpoint SP.
False	The output decreases when the input PV is greater than the setpoint SP.

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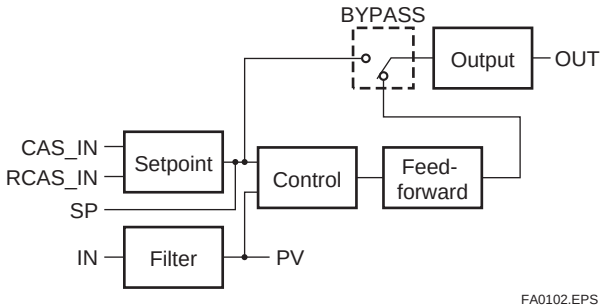
A5.7 Control Action Bypass

The PID control computation can be bypassed so as to set the SP value in the control output OUT as shown below. Setting BYPASS to "On" bypasses the PID control computation.



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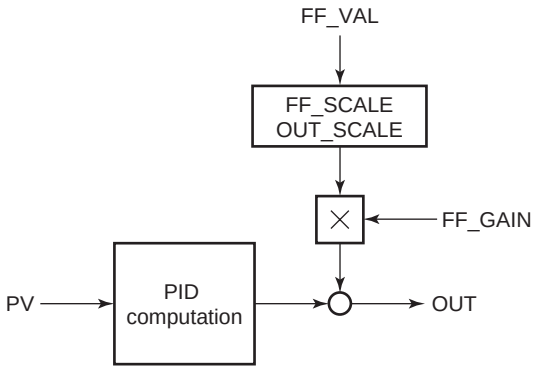
A5.8 Feed-forward

Feed-forward is an action to add a compensation output signal FF_VAL to the output of the PID control computation, and is typically used for feed-forward control. The figure below illustrates the action.



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A5.9 Block Modes

The block mode is set in the parameter MODE-BLK.

MODE_BLK	Target	Stipulates the target mode to which the PID block transfers.
	Actual	Indicates the current mode of the PID block.
	Permitted	Stipulates all the modes that the PID block can enter. The PID block is prohibited from entering any modes other than those set in this element.
	Normal	Stipulates the mode in which the PID block normally resides.

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There are eight modes for a PID block as shown below.

Block Mode	Description
ROut	Remote output mode, in which the PID block outputs the value set in ROUT_IN.
RCas	Remote cascade mode, in which the PID block carries out the PID control computation based on the setpoint (SP) set via the remote cascade connection, such as from a computer, and outputs the computed result.
Cas	Cascade mode, in which the PID block carries out the PID control computation based on the setpoint (SP) set from another fieldbus function block, and outputs the computed result.
Auto	The PID block carries out automatic control and outputs the result computed by the PID control computation.
Man	Manual mode, in which the PID block outputs the value set by the user manually.
LO	The PID block outputs the value set in TRK_VAL.

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Block Mode	Description
IMan	Initialization and manual mode, in which the control action is suspended. The PID block enters this mode when the specified condition is met (see Section A5.14).
O/S	Out of service mode, in which neither the control computation nor action is carried out, and the output is kept at the value that was output before the PID block entered into O/S mode.

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A5.9.1 Mode Transitions

Transition Destination Mode	Condition	NOT Conditions
O/S	1. If O/S is set in **MODE_BLK.target** (or if O/S is set in **target** inside the resource block)	
IMan	2. If the specified condition is met (see Section A5.14)	**NOT** if condition 1 is met
LO	3. If Track Enable is specified in **CONTROL_OPTS** and the value of **TRK_IN_D** is true	**NOT** if either or both of conditions 1 and 2 are met
Man	4. If Man is set in **MODE_BLK.target** or if **IN.status** (input status) is Bad	**NOT** if any one or more of conditions 1 to 3 are met
Auto*	5. If Auto is set in **MODE_BLK.target** **- AND -** if **IN.status** (input status) is not Bad	**NOT** if any one or more of conditions 1 to 3 are met
Cas*, **	6. If Cas is set in **MODE_BLK.target** **- AND -** if neither **IN.status** (input status) nor **CAS_IN.status** is Bad.	**NOT** if any one or more of conditions 1 to 3 are met
RCas*, **	7. If RCas is set in **MODE_BLK.target** **- AND -** if neither **IN.status** (input status) nor **RCAS_IN.status** is Bad.	**NOT** if any one or more of conditions 1 to 3 are met.
ROut*, **	8. If ROut is set in **MODE_BLK.target** **- AND -** if **ROUT_IN.status** (input status) is not Bad	**NOT** if any one or more of conditions 1 to 3 are met.
In accordance with the **SHED_OPT** setting	9. If **RCAS_IN.status** or **ROUT_IN.status** is Bad (indicating a computer failure; see Section A5.17.1 for details)	

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* To activate mode transitions to Auto, Cas, RCas, and ROut, the respective target modes must be set beforehand to MODE_BLK.permitted.

** A transition to Cas, RCas, or ROut requires that initialization of the cascade connection has been completed.

A5.10 Bumpless Transfer

Prevents a sudden change in the control output OUT at changes in block mode (MODE_BLK) and at switching of the connection from the control output OUT to the cascaded secondary function block. The action to perform a bumpless transfer differs depending on the MODE_BLK values.

A5.11 Setpoint Limiters

Active setpoint limiters that limit the changes in the SP value, differ depending on the block mode as follows.

A5.11.1 When PID Block Is in Auto Mode

When the value of MODE_BLK is Auto, the four types of limiters are in force: high limit, low limit, rate-of-increase limit, and rate-of-decrease limit.

Setpoint High/Low Limits

- A value larger than the value of SP_HI_LIM cannot be set for SP.
- A value smaller than the value of SP_LO_LIM cannot be set for SP.

Setpoint Rate Limits

The setpoint rate limits are used to restrict the magnitude of changes in the SP value so as to change the SP value gradually towards a new setpoint.

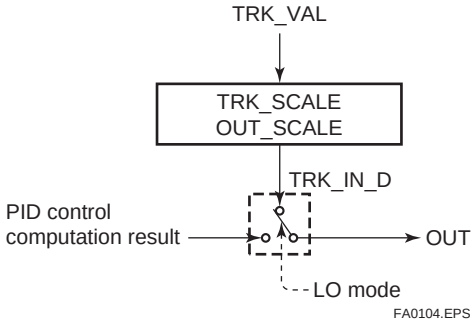
- An increase of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_UP.
- A decrease of the SP value at each execution period (period of execution in the Block Header) is limited to the value of SP_RATE_DOWN.

A5.11.2 When PID Block Is in Cas or RCas Mode

By selecting Obey SP Limits if Cas or RCas in CONTROL_OPTS (see Section A5.13), the setpoint high/low limits can be put into force also when the value of MODE_BLK is Cas or RCas.

A5.12 External-output Tracking

External tracking is an action of outputting the value of the remote output TRK_VAL set from outside the PID block, as illustrated in the figure below. External tracking is performed when the block mode is LO.



To change the block mode to LO:

(1) Select Track Enable in CONTROL_OPTS.
(2) Set TRK_IN_D to true.

However, to change the block mode from Man to LO, Track in Manual must also be specified in CONTROL_OPTS.

A5.13 Measured-value Tracking

Measured-value tracking, also referred to as SP-PV tracking, is an action to equalize the setpoint SP to the measured value PV when the block mode (MODE_BLK.actual) is Man in order to prevent a sudden change in control output from being caused by a mode change to Auto.

While a cascade primary control block is performing the automatic or cascade control (in the Auto or Cas mode), when the mode of its secondary control block is changed from Cas to Auto, the cascade connection is opened and the control action of the primary block stops. The SP of the secondary controller can be equalized to its cascade input signal CAS_IN also in this case.

The settings for measured-value tracking are made in the parameter CONTROL_OPTS, as shown in the table below.

Options in CONTROL_OPTS	Description
Bypass Enable	This parameter allows BYPASS to be set.
SP-PV Track in Man	Equalizes SP to PV when **MODE_BLK.target** is set to Man.
SP-PV Track in ROut	Equalizes SP to PV when **MODE_BLK.target** is set to ROut.
SP-PV Track in LO or IMan	Equalizes SP to PV when actual mode of the block is set to LO or IMan.
SP-PV Track retained Target	Equalizes SP to RCAS_IN when **MODE_BLK.target** is set to RCas, and to CAS_IN when **MODE_BLK.target** is set to Cas when the actual mode of the block is IMan, LO, Man or ROut.
Direct Acting	Set the PID block to a direct acting controller.
Track Enable	This enables the external tracking function. The value in TRK_VAL will replace the value of OUT if TRK_IN_D becomes true and the target mode is not Man.
Track in Manual	This enables TRK_VAL to replace the value of OUT when the target mode is Man and TRK_IN_D is true. The actual mode will then be LO.
Use PV for BKCAL_OUT	Sets the value of PV in BKCAL_OUT and RCAS_OUT, instead of the value of SP.
Obey SP limits if Cas or RCas	Puts the setpoint high/low limits in force in the Cas or RCas mode.
No OUT limits in Manual	Disables the high/low limits for OUT in the Man mode.

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A5.14 Initialization and Manual Fallback (IMan)

Initialization and manual fallback denotes a set of actions in which a PID block changes mode to IMan (initialization and manual) and suspends the control action. Initialization and manual fallback takes place automatically as a means of abnormality handling when the following condition is met:

- The quality component of BKCAL_IN.status is Bad.
  - OR -
- The quality component of BKCAL_IN.status is Good (c)
  - AND -
  The sub-status component of BKCAL_IN.status is FSA, LO, NI, or IR.

The user cannot manually change the mode to IMan. A mode transition to IMan occurs only when the condition above is met.

A5.15 Manual Fallback

Manual fallback denotes an action in which a PID block changes mode to Man and suspends the control action. Manual fallback takes place automatically as a means of abnormality handling when the following condition is met:

- IN.status is Bad except when the control action bypass is on.

To enable the manual fallback action to take place when the above condition is met, Target to Manual if BAD IN must be specified beforehand in STATUS_OPTS.

The table below shows the options in STATUS_OPTS.

Options in STATUS_OPTS	Description
IFS if BAD IN	Sets the sub-status component of **OUT.status** to IFS if **IN.status** is Bad except when PID control bypass is on.
IFS if BAD CAS IN	Sets the sub-status component of **OUT.status** to IFS if **CAS_IN.status** is Bad.
Use Uncertain as Good	Does not regard **IN** as being in Bad status when **IN.status** is Uncertain (to prevent mode transitions from being affected when it is Uncertain).
Target to Manual if BAD IN	Automatically changes the value of **MODE_BLK.target** to MAN when **IN** falls into Bad status.
Target to next permitted mode if BAD CAS IN	Automatically changes the value of **MODE_BLK.target** to Auto (or to Man if Auto is not set in Permitted) when **CAS_IN** falls into Bad status.

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A5.16 Auto Fallback

Auto fallback denotes an action in which a PID block changes mode from Cas to Auto and continues automatic PID control with the user-set setpoint. Auto fallback takes place automatically when the following condition is met:

- IN.status (data status of IN) is Bad except when the control action bypass is on.

To enable the manual fallback action to take place when the above condition is met:

- Target to next permitted mode if BAD CAS IN must be previously specified in STATUS_OPTS.

  - AND -

- Auto must be previously set in MODE_BLK.permitted.

A5.17 Mode Shedding upon Computer Failure

When the data status of RCAS_IN or ROUT_IN, which is the setting received from a computer as the setpoint SP, falls to Bad while the PID block is running in the RCas or ROut mode, the mode shedding occurs in accordance with the settings in SHED_OPT. If the RCAS_IN data is not renewed within the time specified by SHED_RCAS in resource block, the data status of RCAS_IN falls to Bad.

A5.17.1 SHED_OPT

The SHED_OPT setting stipulates the specifications of mode shedding as shown below. Only one can be set.

Available Setting for SHED_OPT	Actions upon Computer Failure
Normal shed, normal return	Sets **MODE_BLK.actual** to Cas*1, and leaves **MODE_BLK.target** unchanged.
Normal shed, no return	Sets both **MODE_BLK.actual** and **MODE_BLK.target** to Cas*1.
Shed to Auto, normal return	Sets **MODE_BLK.actual** to Auto*2, and leaves **MODE_BLK.target** unchanged.
Shed to Auto, no return	Sets both **MODE_BLK.actual** and **MODE_BLK.target** to Auto*2.
Shed to Manual, normal return	Sets **MODE_BLK.actual** to Man, and leaves **MODE_BLK.target** unchanged.
Shed to Manual, no return	Sets both **MODE_BLK.actual** and **MODE_BLK.target** to Man.
Shed to retained target, normal return	If Cas is in **MODE_BLK.target**, sets **MODE_BLK.actual** to Cas*1, and leaves **MODE_BLK.target** unchanged. If Cas is not set in **MODE_BLK.target**, sets **MODE_BLK.actual** to Auto*2, and leaves **MODE_BLK.target** unchanged.
Shed to retained target, no return	If Cas is set in **MODE_BLK.target**, sets both **MODE_BLK.actual** and **MODE_BLK.target** to Cas*1. If Cas is not set in **MODE_BLK.target**, sets **MODE_BLK.actual** to Auto*2, and **MODE_BLK.target** to Cas.

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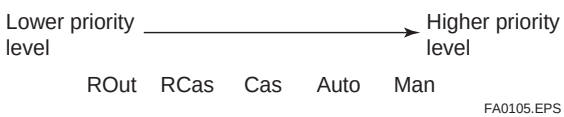
*1 The modes to which a PID block can transfer are limited to those set in MODE_BLK.permitted, and the priority levels of modes are as shown below. In fact, if Normal shed, normal return is set for SHED_OPT, detection of a computer failure causes MODE_BLK.actual to change to Cas, Auto, or MAN, whichever is set in MODE_BLK. permitted and has the lowest priority level.



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*2 Only when Auto is set as permitted mode.

NOTE: If a control block is connected as a cascade primary block of the PID block in question, a mode transition of the PID block to Cas occurs in the following sequence due to initialization of the cascade connection: RCas or ROut → Auto → Cas.

A5.18 Alarms

There are two kinds of alarms generated by a PID block: block and process alarms.

A5.18.1 Block Alarm (BLOCK_ALM)

The block alarm BLOCK_ALM is generated upon occurrence of either of the following errors (values set in BLOCK_ERR) and notifies the content of BLOCK_ERR.

Value of BLOCK_ERR	Condition
Local Override	**MODE_BLK** actual of PID block is LO.
Input Failure	**IN.status** of the PID block is either of the following: • Bad-Device Failure • Bad-Sensor Failure
Out of Service	**MODE_BLK.target** of the PID block is O/S.

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A5.18.2 Process Alarms

There are six types of process alarms. Only one process alarm can be generated at the same time, and the process alarm having the highest priority level from among those occurring at the same time is generated. The priority level is set for each process alarm type.

Process Alarm	Cause of Occurrence	Parameter Containing Priority Level Setting
HI_HI_ALM	Occurs when the PV increases above the HI_HI_LIM value.	HI_HI_PRI
HI_ALM	Occurs when the PV increases above HI_LIM value.	HI_PRI
LO_ALM	Occurs when the PV decreases below the LO_LIM value.	LO_PRI
LO_LO_ALM	Occurs when the PV decreases below the LO_LO_LIM value.	LO_LO_PRI
DV_HI_ALM	Occurs when the value of [PV - SP] increases above the DV_HI_LIM value.	DV_HI_PRI
DV_LO_ALM	Occurs when the value of [PV - SP] decreases below the DV_LO_LIM value.	DV_LO_PRI

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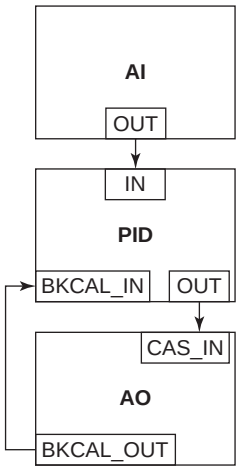
A5.19 Example of Block Connections



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When configuring a simple PID control loop by combining an EJX transmitter with a fieldbus valve positioner that contains an AO block, follow the procedure below to make the settings of the corresponding fieldbus function blocks:

1. Connect the AI block and PID block of the EJX, and the AO block of the valve positioner as shown above.
2. Set MODE_BLK.target of the PID block to O/S, and then set GAIN, RESET, and RATE to appropriate values.
3. Check that the value of MODE_BLK.actual of the AI block is Auto.
4. Set MODE_BLK.target of the AO block to CAS|AUTO (meaning "Cas and Auto").
5. Check that the value of BKCAL_IN.status of the PID block is not Bad.
6. Check that the value of IN.status of the PID block is not Bad.
7. Check that Auto is set in MODE_BLK.permitted of the PID block.
8. Set MODE_BLK.target of the PID block to Auto.

When finishing all steps in order, the PID block and AO block exchange the respective information and initialize the cascade connection. Consequently, the value of MODE_BLK.actual of the PID block changes to Auto and automatic PID control starts.

A5.20 View Object for PID Function Block

Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
1	ST_REV	2	2	2	2
2	TAG_DESC				
3	STRATEGY				2
4	ALERT_KEY				1
5	MODE_BLK	4		4	
6	BLOCK_ERR	2		2	
7	PV	5		5	
8	SP	5		5	
9	OUT	5		5	
10	PV_SCALE		11		
11	OUT_SCALE		11		
12	GRANT_DENY		2		
13	CONTROL_OPTS				2
14	STATUS_OPTS				2
15	IN			5	
16	PV_FTIME				4
17	BYPASS		1		
18	CAS_IN	5		5	
19	SP_RATE_DN				4
20	SP_RATE_UP				4
21	SP_HI_LIM		4		
22	SP_LO_LIM		4		
23	GAIN				4
24	RESET				4
25	BAL_TIME				4
26	RATE				4
27	BKCAL_IN			5	
28	OUT_HI_LIM		4		
29	OUT_LO_LIM		4		
30	BKCAL_HYS				4
31	BKCAL_OUT			5	
32	RCAS_IN			5	
33	ROUT_IN			5	
	Subtotals	28	43	53	41

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Relative Index	Parameter Mnemonic	VIEW 1	VIEW 2	VIEW 3	VIEW 4
34	SHED_OPT				1
35	RCAS_OUT			5	
36	ROUT_OUT			5	
37	TRK_SCALE				11
38	TRK_IN_D	2		2	
39	TRK_VAL	5		5	
40	FF_VAL			5	
41	FF_SCALE				11
42	FF_GAIN				4
43	UPDATE_EVT				
44	BLOCK_ALM				
45	ALARM_SUM	8		8	
46	ACK_OPTION				2
47	ALARM_HYS				4
48	HI_HI_PRI				1
49	HI_HI_LIM				4
50	HI_PRI				1
51	HI_LIM				4
52	LO_PRI				1
53	LO_LIM				4
54	LO_LO_PRI				1
55	LO_LO_LIM				4
56	DV_HI_PRI				1
57	DV_HI_LIM				4
58	DV_LO_PRI				1
59	DV_LO_LIM				4
60	HI_HI_ALM				
61	HI_ALM				
62	LO_ALM				
63	LO_LO_ALM				
64	DV_HI_ALM				
65	DV_LO_ALM				
	Subtotals	15	0	30	63
	Totals	43	43	83	104

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APPENDIX 6. LINK MASTER FUNCTIONS

A6.1 Link Active Scheduler

A link active scheduler (LAS) is a deterministic, centralized bus scheduler that can control communications on an H1 fieldbus segment. There is only one LAS on an H1 fieldbus segment.

An EJX multivariable transmitter supports the following LAS functions.

- PN transmission: Identifies a fieldbus device newly connected to the same fieldbus segment. PN is short for Probe Node.
- PT transmission: Passes a token governing the right to transmit, to a fieldbus device on the same segment. PT is short for Pass Token.
- CD transmission: Carry out a scheduled transmission to a fieldbus device on the same segment. CD is short for Compel Data.
- Time synchronization: Periodically transmits the time data to all fieldbus devices on the segment and returns the time data in response to a request from a device.
- Live list equalization: Sends the live list data to link masters on the same segment.
- LAS transfer: Transfers the right to be the LAS on the segment to another link master.

A6.2 Link Master

A link master (LM) is any device containing a link active scheduler. There must be at least one LM on a segment. When the LAS on a segment has failed, another LM on the same segment starts working as the LAS.

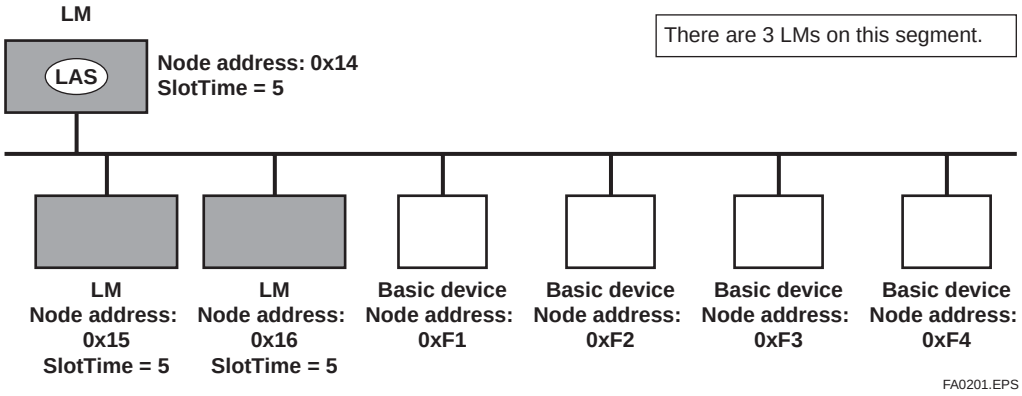

Figure A6.1 Example of Fieldbus configuration-3 LMs on Same Segment

A6.3 Transfer of LAS

There are two procedures for an LM to become the LAS:

- If the LM whose value of [V(ST)×V(TN)] is the smallest on a segment, with the exception of the current LAS, judges that there is no LAS on the segment, in such a case as when the segment has started up or when the current LAS has failed, the LM declares itself as the LAS, then becomes the LAS. (With this procedure, an LM backs up the LAS as shown in the following figure.)
- The LM whose value of [V(ST)×V(TN)] is the smallest on a segment, with the exception of the current LAS, requests the LAS on the same segment to transfer the right of being the LAS, then becomes the LAS.

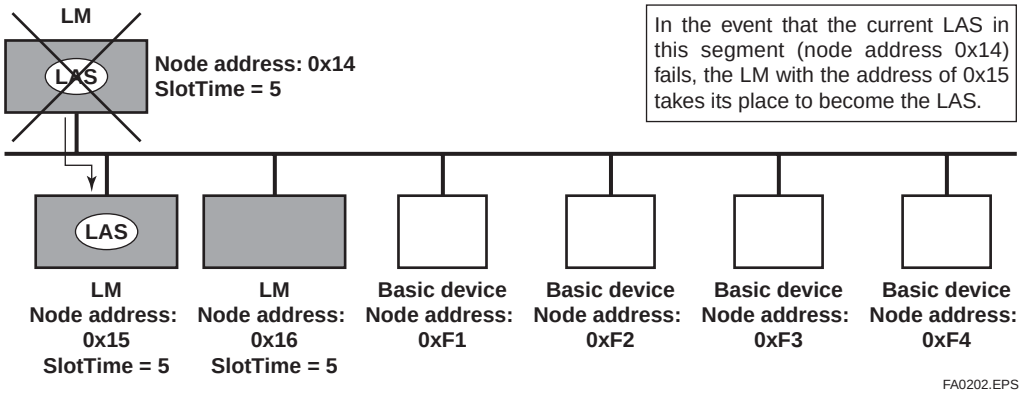

Figure A6.2 Backup of LAS

To set up an EJX as a device that is capable of backing up the LAS, follow the procedure below.

NOTE: When changing the settings in an EJX, add the EJX to the segment in which an LAS is running. After making changes to the settings, do not turn off the power to the EJX for at least 30 seconds.

(1) Set the node address of the EJX910A. In general, use an address from 0x10 to [V(FUN) - 1].

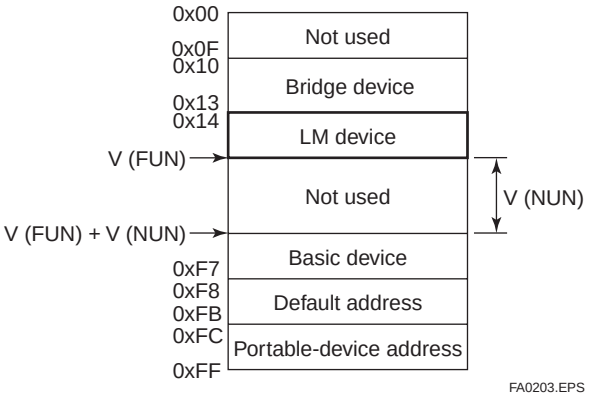

Figure A6.3 Node Address Ranges

(2) In the LAS settings of the EJX, set the values of V(ST), V(MRD), and V(MID) to the same as the respective lowest capability values in all the devices within the segment. An example is shown below.

DlmeBasicInfo (EJX Index 361 (SM))

Sub-index	Element	EJX	Device 1	Device 2	Device 3	Description
1	SlotTime	4	8	10	20	Capability value for V(ST)
3	MaxResponse Delay	3	6	3	5	Capability value for V(MRD)
6	MinInterPdu Delay	4	8	12	10	Capability value for V(MID)

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In this case, set SlotTime, MaxResponseTime, and MinInterPduDelay as follows:

ConfiguredLinkSettingsRecord (EJX Index 369 (SM))

Subindex	Element	Setting (Default)	Description
1	SlotTime	20(4095)	V (ST)
3	MaxResponseDelay	6(5)	V (MRD)
6	MinInterPduDelay	12(12)	V (MID)

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(3) In the LAS settings of the EJX, set the values of V(FUN) and V(NUN) so that they include the node addresses of all nodes within the same segment. (See also Figure 3.)

ConfiguredLinkSettingsRecord (EJX Index 369 (SM))

Subindex	Element	Default Value	Description
4	FirstUnpolledNodeId	0x25	V (FUN)
7	NumConsecUnpolledNodeId	0xBA	V (NUN)

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A6.4 LM Functions

No.	Function	Description
1	LM initialization	When a fieldbus segment starts, the LM with the smallest [V(ST) × V(TN)] value within the segment becomes the LAS. At all times, each LM is checking whether or not a carrier is on the segment.
2	Startup of other nodes (PN and Node Activation SPDU transmissions)	Transmits a PN (Probe Node) message, and Node Activation SPDU message to devices which return a new PR (Probe Response) message.
3	PT transmission (including final bit monitoring)	Passes a PT (Pass Token) message to devices included in the live list sequentially, and monitors the RT (Return Token) and final bit returned in reply to the PT.
4	CD transmission	Transmits a CD (Compel Data) message at the scheduled times.
5	Time synchronization	Supports periodic TD (Time Distribution) transmissions and transmissions of a reply to a CT (Compel Time).
6	Domain download server	Sets the schedule data. The schedule data can be equalized only when the Domain Download command is carried out from outside the LM in question. (The version of the schedule is usually monitored, but no action takes place, even when it changes.)
7	Live list equalization	Transmits SPDU messages to LMs to equalize live lists.
8	LAS transfer	Transfers the right of being the LAS to another LM.
9	Reading/writing of NMIB for LM	See Section A6.5.
10	Round Trip Delay Reply (RR) Reply to DLPDU	Not yet supported in the current version.
11	Long address	Not yet supported in the current version.

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A6.5 LM Parameters

A6.5.1 LM Parameter List

The tables below show LM parameters.

Meanings of **Access** column entries: RW = read/write possible; R = read only

Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
362	DLME_LINK_MASTER_CAPABILITIES_VARIABLE		0x04	RW	
363	DLME_LINK_MASTER_INFO_RECORD	0		RW	
		1 MaxSchedulingOverhead	0		
		2 DefMinTokenDelegTime	100		
		3 DefTokenHoldTime	300		
		4 TargetTokenRotTime	4096		
		5 LinkMaintTokHoldTime	400		
		6 TimeDistributionPeriod	5000		
		7 MaximumInactivityToClaimLasDelay	2		
		8 LasDatabaseStatusSpduDistributionPeriod	6000		
364	PRIMARY_LINK_MASTER_FLAG_VARIABLE		0	RW	LAS: True = 0xFF; non-LAS: False = 0x00
365	LIVE_LIST_STATUS_ARRAY_VARIABLE		0	R	
366	MAX_TOKEN_HOLD_TIME_ARRAY	0		RW	
		1 Element1	0		
		2 Element2	0		
		3 Element3	0		
		4 Element4	0		
		5 Element5	0		
		6 Element6	0		
		7 Element7	0		
		8 Element8	0		
367	BOOT_OPERAT_FUNCTIONAL_CLASS		Specified at the time of order	RW	0x01 (basic device); 0x02 (LM)
368	CURRENT_LINK_SETTING_RECORD	0		R	Settings for LAS
		1 SlotTime	0		
		2 PerDlpduPhlOverhead	0		
		3 MaxResponseDelay	0		
		4 FirstUnpolledNodeId	0		
		5 ThisLink	0		
		6 MinInterPduDelay	0		
		7 NumConseeUnpolledNodeId	0		
		8 PreambleExtension	0		
		9 PostTransGapExtension	0		
		10 MaxInterChanSignalSkew	0		
		11 TimeSyncClass	0		
369	CONFIGURED_LINK_SETTING_RECORD	0		RW	
		1 SlotTime	4095		
		2 PerDlpduPhlOverhead	4		
		3 MaxResponseDelay	5		
		4 FirstUnpolledNodeId	37		
		5 ThisLink	0		
		6 MinInterPduDelay	12		
		7 NumConseeUnpolledNodeId	186		
		8 PreambleExtension	2		
		9 PostTransGapExtension	1		
		10 MaxInterChanSignalSkew	0		
		11 TimeSyncClass	4		

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Index (SM)	Parameter Name	Sub-parameter Name (Sub Index)	Default Factory Setting	Access	Remarks
370	PLME_BASIC_ CHARACTERISTICS	0		R	
		1 ChannelStatisticsSupported	0x00		
		2 MediumAndDataRatesSupported	0x4900000000000000		
		3 IecVersion	1 (0x1)		
		4 NumOfChannels	1 (0x1)		
		5 PowerMode	0 (0x0)		
371	CHANNEL_STATES	0		R	
		1 channel-1	0 (0x0)		
		2 channel-2	128 (0x80)		
		3 channel-3	128 (0x80)		
		4 channel-4	128 (0x80)		
		5 channel-5	128 (0x80)		
		6 channel-6	128 (0x80)		
		7 channel-7	128 (0x80)		
		8 channel-8	128 (0x80)		
372	PLME_BASIC_INFO	0		R	
		1 InterfaceMode	0 (0x0)		
		2 LoopBackMode	0 (0x0)		
		3 XmitEnabled	1 (0x1)		
		4 RcvEnabled	1 (0x1)		
		5 PreferredReceiveChannel	1 (0x1)		
		6 MediaTypeSelected	73 (0x49)		
		7 ReceiveSelect	1 (0x1)		
373	LINK_SCHEDULE_ACTIVATION_VARIABLE		0 (0x0)	RW	
374	LINK_SCHEDULE_LIST_ CHARACTERISTICS_ RECORD	0		R	
		1 NumOfSchedules	0		
		2 NumOfSubSchedulesPerSchedule	1		
		3 ActiveScheduleVersion	0		
		4 ActiveSheduleOdIndex	0		
		5 ActiveScheduleStartingTime	0		
375	DLME_SCHEDULE_ DESCRIPTOR.1	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
376	DLME_SCHEDULE_ DESCRIPTOR.2	0		R	
		1 Version	0		
		2 MacrocycleDuration	0		
		3 TimeResolution	0		
377	DOMAIN.1				Read/write impossible. Get-OD possible.
378	DOMAIN.2				Read/write impossible. Get-OD possible.

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A6.5.2 Descriptions for LM Parameters

The following describes LM parameters of an EJX multivariable transmitter.

NOTE: Do not turn off the power to the EJX for 60 seconds after making a change to its parameter settings.

(1) DlmeLinkMasterCapabilitiesVariable

Bit Position	Meaning	Description	Value
B3: 0x04	LAS Schedule in Non-volatile Memory	Whether the LAS schedule can (= 1) or cannot (= 0) be saved to the non-volatile memory	1
B2: 0x02	Last Values Record Supported	Whether to support (= 1) or not to support (= 0) LastValuesRecord.	0
B1: 0x01	Link Master Statistics Record Supported	Whether to support (= 1) or not to support (= 0) DlmeLinkMasterStatisticsRecord.	0

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(2) DlmeLinkMasterInfoRecord

Sub-index	Element	Size [bytes]	Descrip-tion
1	MaxSchedulingOverhead	1	V(MSO)
2	DefMinTokenDelegTime	2	V(DMDT)
3	DefTokenHoldTime	2	V(DTHT)
4	TargetTokenRotTime	2	V(TTRT)
5	LinkMaintTokHoldTime	2	V(LTHT)
6	TimeDistributionPeriod	4	V(TDP)
7	MaximumInactivityToClaimLasDelay	2	V(MICD)
8	LasDatabaseStatusSpduDistributionPeriod	2	V(LDDP)

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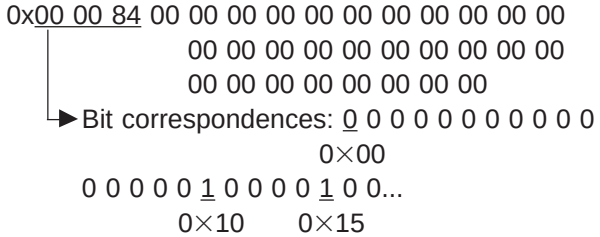
(3) PrimaryLinkMasterFlagVariable

Explicitly declares the LAS. Writing “true” (0xFF) to this parameter in a device causes that device to attempt to become the LAS. However, a request of writing “true” to this parameter in a device is rejected if the value of the same parameter in any other device that has a smaller node address within the same segment is true.

(4) LiveListStatusArrayVariable

A 32-byte variable, in which each bit represents the status of whether a device on the same segment is live or not. The leading bit corresponds to the device address 0x00, and final bit to 0xFF. The value of LiveListStatusArrayVariable in the case where devices having the addresses 0x10 and 0x15 in the fieldbus segment is shown below.



(5) MaxTokenHoldTimeArray

An 8×64 byte array variable, in which each set of 2 bytes represents the delegation time (set as an octet time) assigned to a device. The delegation time denotes a time period that is given to a device by means of a PT message sent from the LAS within each token circulation cycle.

The leading 2 bytes correspond to the device address 0x00, and the final 2 bytes to the device address 0xFF. Specify the subindex to access this parameter.

(6) BootOperatFunctionalClass

Writing 1 to this parameter in a device and restarting the device causes the device to start as a basic device. On the contrary, writing 2 to this parameter and restarting the device causes the device to start as an LM.

(7) CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord

CurrentLinkSettingRecord indicates the bus parameter settings currently used. ConfiguredLinkSettingsRecord indicates the bus parameter settings to be used when the device becomes the LAS. Thus, when a device is the LAS, its CurrentLinkSettingRecord and ConfiguredLinkSettingsRecord have the same values.

Sub-index	Element	Size [bytes]	Descrip-tion
1	SlotTime	2	V(ST)
2	PerDlpduPhlOverhead	1	V(PhLO)
3	MaxResponseDelay	1	V(MRD)
4	FirstUnpolledNodeId	1	V(FUN)
5	ThisLink	2	V(TL)
6	MinInterPduDelay	1	V(MID)
7	NumConsecUnpolledNodeId	1	V(NUN)
8	PreambleExtension	1	V(PhPE)
9	PostTransGapExtension	1	V(PhGE)
10	MaxInterChanSignalSkew	1	V(PhIS)
11	TimeSyncClass	1	V(TSC)

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(8) DlmeBasicInfo

Sub-index	Element	Size [bytes]	Description
1	SlotTime	2	Indicates the capability value for V(ST) of the device.
2	PerDlpduPhlOverhead	1	V(PhLO)
3	MaxResponseDelay	1	Indicates the capability value for V(MRD) of the device.
4	ThisNode	1	V(TN), node address
5	ThisLink	2	V(TL), link-id
6	MinInterPduDelay	1	Indicates the capability value for V(MID) of the device.
7	TimeSyncClass	1	Indicates the capability value for V(TSC) of the device.
8	PreambleExtension	1	V(PhPE)
9	PostTransGapExtension	1	V(PhGE)
10	MaxInterChanSignalSkew	1	V(PhIS)

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(9) PlmeBasicCharacteristics

Sub-index	Element	Size [bytes]	Value	Description
1	Channel Statistics Supported	1	0	Statistics data are not supported.
2	Medium AndData Rates Supported	8	0x4900000000000000	Wire medium, voltage mode, and 31.25 kbps are supported.
3	IceVersion	2	0x0403	IEC 4.3 is supported.
4	NumOf Channels	1	1	
5	Power Mode	1	0	0: Bus-powered; 1: Self-powered

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(10) ChannelStates

Sub-index	Element	Size [bytes]	Value	Description
1	Channel 1	1	0x00	In Use, No Bad since last read, No Silent since last read, No Jabber since last read, Tx Good, Rx Good
2	Channel 2	1	0x80	Unused
3	Channel 3	1	0x80	Unused
4	Channel 4	1	0x80	Unused
5	Channel 5	1	0x80	Unused
6	Channel 6	1	0x80	Unused
7	Channel 7	1	0x80	Unused
8	Channel 8	1	0x80	Unused

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(11) PlmeBasicInfo

Sub-index	Element	Size [bytes]	Value	Description
1	InterfaceMode	1	0	0: Half duplex; 1: Full duplex
2	LoopBackMode	1	0	0: Disabled; 1: MAU; 2: MDS
3	XmitEnabled	1	0x01	Channel 1 is enabled.
4	RcvEnebled	1	0x01	Channel 1 is enabled.
5	PreferredReceive Channel	1	0x01	Channel 1 is used for reception.
6	MediaType Selected	1	0x49	Wire medium, voltage mode, and 31.25 kbps are selected.
7	ReceiveSelect	1	0x01	Channel 1 is used for reception.

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(12) LinkScheduleActivationVariable

Writing the version number of an LAS schedule, which has already been downloaded to the domain, to this parameter causes the corresponding schedule to be executed. On the other hand, writing 0 to this parameter stops execution of the active schedule.

(13) LinkScheduleListCharacteristicsRecord

Sub-index	Element	Size [bytes]	Description
1	NumOf Schedules	1	Indicates the total number of LAS schedules that have been downloaded to the domain.
2	NumOfSub SchedulesPer Schedule	1	Indicates the maximum number of sub-schedules an LAS schedule can contain. (This is fixed to 1 in the Yokogawa communication stacks.)
3	ActiveSchedule Version	2	Indicates the version number of the schedule currently executed.
4	ActiveSchedule OdIndex	2	Indicates the index number of the domain that stores the schedule currently executed.
5	ActiveSchedule StaringTime	6	Indicates the time when the current schedule began being executed.

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(14) DlmeScheduleDescriptor

This parameter exists for the same number as the total number of domains, and each describes the LAS schedule downloaded to the corresponding domain. For the domain to which a schedule has not yet been downloaded, the values in this parameter are all zeros.

Sub-index	Element	Size [bytes]	Description
1	Version	2	Indicates the version number of the LAS schedule downloaded to the corresponding domain.
2	Macrocycle Duration	4	Indicates the macro cycle of the LAS schedule downloaded to the corresponding domain.
3	TimeResolution	2	Indicates the time resolution that is required to execute the LAS schedule downloaded to the corresponding domain.

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(15) Domain

Read/write: impossible; get-OD: possible

Carrying out the GenericDomainDownload command from a host writes an LAS schedule to Domain.

CAUTION

When downloading a LAS schedule to EJX, maximum allowable linkages between devices are 18.

A6.6 FAQs

Q1. When the LAS stops, an EJX does not back it up by becoming the LAS. Why?

A1-1. Is that EJX running as an LM? Check that the value of BootOperatFunctionalClass (index 367) is 2 (indicating that it is an LM).

A1-2. Check the values of V(ST) and V(TN) in all LMs on the segment and confirm that the following condition is met:

EJX		Other LMs
V(ST)×V(TN)	<	V(ST)×V(TN)

Q2. How can I make an EJX become the LAS?

A2-1. Check that the version numbers of the active schedules in the current LAS and the EJX are the same by reading:

LinkScheduleListCharacteristicsRecord (index 374 for an EJX)

- ActiveScheduleVersion (subindex 3)

A2-2. Make the EJX declare itself as and become the LAS by writing:

- 0x00 (false) to PrimaryLinkMasterFlagVariable in the current LAS; and
- 0xFF (true) to PrimaryLinkMasterFlagVariable (index 364) in the EJX.

Q3. On a segment where an EJX works as the LAS, another device cannot be connected. How come?

A3-1. Check the following bus parameters that indicate the bus parameter as being the LAS for the EJX and the capabilities of being the LAS for the device that cannot be connected:

- V(ST), V(MID), V(MRD) of EJX: ConfiguredLinkSettingsRecord (index 369)
- V(ST), V(MID), V(MRD) of problematic device: DlmeBasicInfo

Then, confirm that the following conditions are met:

EJX		Problematic Device
V(ST)	>	V(ST)
V(MID)	>	V(MID)
V(MRD)	>	V(MRD)

A3-2. Check the node address of the problematic device is not included in the V(FUN)+V(NUN) of the EJX.

Q4. "AL.20" is kept shown on LCD.

The LAS does not exist or is not identified in the fieldbus network, or the EJX is not able to establish communication with the LAS.

A4-1. Check that the LAS is connected on the network. When using the EJX as the LAS, follow the steps described in section A6.3.

A4-2. Adjust the parameters of the LAS to that of the EJX. Refer to section 5.2 for details.

LAS		EJX
V(ST)	>	V(ST) 4 or above
V(MID)	>	V(MID) 4 or above
V(MRD)	>	V(MRD) 12 or above

A4-3. Check that the correct Node Address is used for the EJX. Refer to section 5.2 for details. Confirm that the Node Address of EJX should be out of the parameters of the LAS of V (FUN) ~V (FUN)+V (NUN)

Confirm that the Node Address is not within the default address (0xF8 to 0xFB).

APPENDIX 7. SOFTWARE DOWNLOAD

A7.1 Benefits of Software Download

This function enables you to download software to field devices via a FOUNDATION Fieldbus to update their software. Typical uses are to add new features such as function blocks and diagnostics to existing devices, and to optimize existing field devices for your plant.

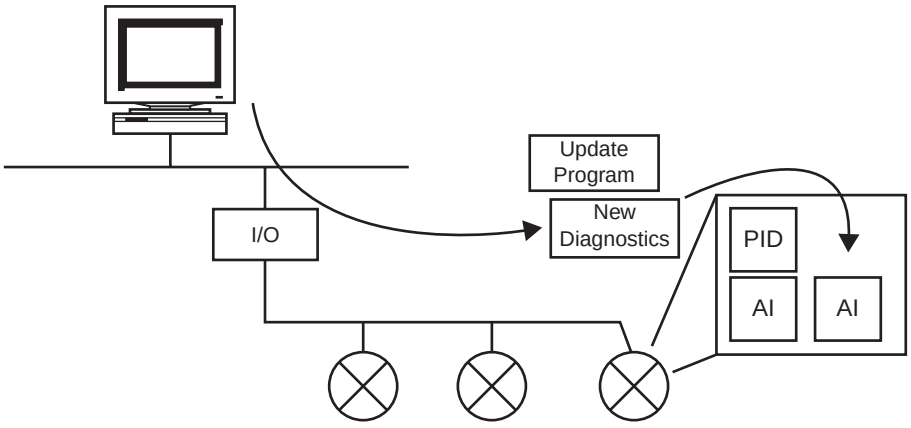

Figure A7.1 Concept of Software Downloading

A7.2 Specifications

Steady-state current: Max. 15 mA

Current Draw (Steady-state): 15mA (max)

Current Draw (Software Download state): 24mA (max)

Current during FlashROM blanking time:
Max. 24 mA additional to steady-state current

Based on Fieldbus Foundation Specification Download class: Class 1

NOTE

Class 1 devices can continue the specified measurement and/or control actions even while software is being downloaded to them. Upon completion of a download, however, the devices will be reset internally to make the new, downloaded software take effect, and this will halt fieldbus communication and function block executions for about one minute.

A7.3 Preparations for Software Downloading

For software downloading, you need to prepare the following:

- Software download tool
- Software for downloading file for each of the target field devices

For the software download tool, use only a program developped for that purpose. For details, see the software's User's Manual. For information about updates of software binary files for field devices and how to obtain them, visit the following web site.

http://www.yokogawa.com/fld/fld-top-en.htm

CAUTION

Do not hook up the software download tool to a fieldbus segment while the plant is in operation, as it may temporarily disturb the communication. Always connect the tool before starting operation.

NOTE

The download tool can not execute downloading during other system connects to the system/ network management VFD of the device.

A7.4 Software Download Sequence

The flowchart below outlines the software download procedure. Although the time taken for the entire procedure varies depending on the size of the field bus device's software, it generally take about 20 minutes where there is a one-to-one connection between a fieldbus device and download tool, and longer when multiple field devices are connected to the fieldbus.

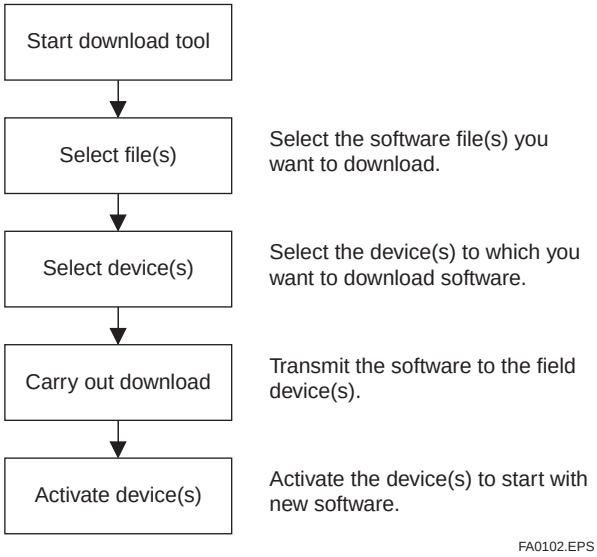
Start download tool
Select file(s)
Select the software file(s) you want to download.
Select device(s)
Select the device(s) to which you want to download software.
Carry out download
Transmit the software to the field device(s).
Activate device(s)
Activate the device(s) to start with new software.
FA0102.EPS

Figure A7.2 Flow of Software Download Procedure

CAUTION

Carrying out a software download leaves the PD tag, node address, and transducer block calibration parameters that are retained in the nonvolatile memory inside the target device, but may reset other parameters to the defaults (except a minor update that does not change the number of parameters). Hence, where necessary, save the parameters using an engineering tool, parameter setting utility, or the like before carrying out a software download, and then reconfigure the field device(s) after the download. For details, see Section A7.6.

CAUTION

The current dissipation of the target field device increases transitorily immediately after a download due to erasing of the FlashROM's contents. Use a fieldbus power supply which has sufficient capacity to cover such increases in feed current.

CAUTION

Upon completion of the activation, the target fieldbus device performs resetting internally, which temporarily halts fieldbus communication and function block executions. Be especially careful about a valve positioner; the output air pressure will fall to the minimum level (i.e., zero).

CAUTION

Do not turn off the power to a field device or disconnect the download tool during a download or activation. The device may fail as a result.

NOTE

Be careful about the noise on the fieldbus link. If the fieldbus is noisy, the downloading may take a very long time or fail.

A7.5 Download Files

Download files have the following filenames (with the filename extension of ".ffd"). Take care to choose the correct download file for the target field device:

"594543" + device family + "_" + device type + "_" + domain name + "_" + software name + "_" + software revision + ".ffd"

For example, the name of the download file for an EJX multivariable transmitter may have the following name:

5945430008_000E_EJX910A_ORIGINAL_R101.ffd

Refer to A7.11(3) DOMAIN_HEADER about each keyword of the file name.

The device type is “000E” for an EJX multivariable transmitter.

The software name is “ORIGINAL” or “UPDATE.” The former indicates an original file and the latter an update file. Whenever performing a download to update the device revision, obtain the original file. In general, an addition to the parameters or blocks requires a device revision update.

A7.6 Steps after Activating a Field Device

When the communication with a field device has recovered after activating the device, check using the download tool that the software revision of the field device has been updated accordingly. The value of SOFT_REV of the resource block indicates the software revision.

The PD tag, node address, and transducer block calibration parameters that are retained in the nonvolatile memory inside the target device will remain unchanged after a software download. However, after a software update which causes an addition to the block parameters or blocks, or to the system/network management VFD parameters, some parameters may be reset to the defaults, thus requiring parameter setup and engineering again. For details, see the table below.

Also note that a change in the number of parameters or blocks requires the DD and capabilities files corresponding to the new software revision.

Table 1. Actions after Software Update

Contents of Software Update	Action
Does not change the number of parameters.	Re-setup of parameters not needed.
Adds a block parameter.	Setup of the added parameter needed.
Adds a block.	Reengineering and setup of the added block’s parameters needed.
Changes the number of system/network management VFD parameters.	Reengineering needed.

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A7.7 Troubleshooting

For information on the download tool's error messages, see also the software's User's Manual.

Table A7.2 Problems after Software Update

Symptom	Cause	Remedy
An error occurs before starting a download, disabling the download.	The selected download file is not for the selected field device.	Check SOFTDWN_ERROR in the resource block and obtain the correct file.
An error occurs after starting a download, disabling the download.	You attempted to update the device revision by downloading a file which is not an original file.	Check SOFTDWN_ERROR in the resource block and obtain the original file.
	The selected field device does not support software downloading.	Check whether the option code /EE is included in the model and suffix codes of the device.
	The voltage on the fieldbus segment falls below the specified limit (9 volts).	Check the capacity of the field bus power supply used and the voltage at the terminal.
	There was an error in a checksum or the number of transmission bytes.	Check SOFTDWN_ERROR in the resource block and obtain the correct file.
	The download tool does not allow download with same software revision.	Check the setting of the download tool.
The download takes far longer than expected or fails frequently.	The fieldbus segment is noisy.	Check the noise level on the fieldbus segment.
An error occurs after activation.	Transient error caused by the internal resetting of the field device	Check whether communication with the field device has recovered after a while.
The new software does not work after the activation.	The file of the current revision was downloaded.	Obtain the correct file.
	Failure of the memory in field device, etc.	Check SOFTDWN_ERROR in the resource block, and re-try downloading. If fails, place a service call.

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A7.8 Resource Block's Parameters Relating to Software Download

Table A7.3 Additional Parameters of Resource Block

Relative Index	Index	Parameter Name	Default (Factory Set)	Write Mode	Description
53	1053	SOFTDWN_PROTECT	0x01		Defines whether to accept software downloads. 0x01: Unprotected 0x02: Protected
54	1054	SOFTDWN_FORMAT	0x01		Selects the software download method. 0x01: Standard
55	1055	SOFTDWN_COUNT	0	—	Indicates the number of times the internal FlashROM was erased.
56	1056	SOFTDWN_ACT_AREA	0	—	Indicates the ROM number of the currently working FlashROM. 0: FlashROM #0 working 1: FlashROM #1 working
57	1057	SOFTDWN_MOD_REV	1, 0, 0, 0, 0, 0, 0, 0	—	Indicates the software module revision.
58	1058	SOFTDWN_ERROR	0	—	Indicates an error during a software download. See Table 4.

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Table A7.4 Download Error Codes

Error Code	Detail
0	No error
32768	Unsupported header version
32769	Abnormal header size
32770	Abnormal manufacturer ID
32771	Abnormal device family
32772	Abnormal device revision
32773	Abnormal vendor specification version
32774	Abnormal number of modules
32775	Abnormal number of bytes in module 1
32776	Abnormal number of bytes in module 2
32777	Device error in module 1
32778	Checksum error in module 1
32779	Checksum error in file
32780	Unused
32781	Write-prohibited area in FlashROM
32782	Verification error during FlashROM writing
32783	Polling error during FlashROM erasing
32784	Polling time-out during FlashROM erasing
32785	Polling error during FlashROM writing
32786	Polling time-out during FlashROM writing
32787	FlashROM driver undefined number error
32788	File endcode error
32789	File type error (UPDATE, ORIGINAL)
32790	FlashROM driver undefined number error
32791	On-start state error (other than DWNLD_NOT_READY)
32792	Start segment error in module 1
32793	Binary file error
32794	Binary file error
32795	Device error in module 2
32796	Detection of EEPROM state other than backup after activation
32797	Checksum error in module 2
32798	Not in DWNLD_READY state when receiving GenericDomainInitiate
32799	Not in DWNLD_OK state when receiving GenericDomainTerminate
32800	Not in DOWNLOADING state when receiving GenericDomainSegment
32801	Firmware error
36863	Unused

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A7.9 System/Network Management VFD Parameters Relating to Software Download

Table A7.5 System/Network Management VFD Parameters

Write Mode: R/W = read/write; R = read only

Index (SM)	Parameter Name	Sub Index	Sub-parameter Name	Default (Factory Set)	Write Mode	Remarks
400	DWNLD_PROPERTY	0			R	
		1	Download Class	1		
		2	Write Rsp Returned For ACTIVATE	1		
		3	Write Rsp Returned For PREPARE	1		
		4	Reserved	0		
		5	ReadyForDwnld Delay Secs	300		
		6	Activation Delay Secs	60		
410	DOMAIN_DESCRIPTOR	0			R/W	Read/write-permitted only for sub-index 1
		1	Command	3		
		2	State	1		
		3	Error Code	0		
		4	Download Domain Index	440		
		5	Download Domain Header Index	420		
		6	Activated Domain Header Index	430		
		7	Domain Name	(Device name)		
420	DOMAIN_HEADER.1	0				
		1	Header Version Number	0		
		2	Header Size	0		
		3	Manufacturer ID			
		4	Device Family			
		5	Device Type			
		6	Device Revision	0		
		7	DD Revision	0		
		8	Software Revision			
		9	Software Name			
		10	Domain Name			
430	DOMAIN_HEADER.2	0				
		1	Header Version Number	1		
		2	Header Size	44		
		3	Manufacturer ID	0x594543		
		4	Device Family	(DEV_TYPE of RB)		
		5	Device Type	(DEV_TYPE of RB)		
		6	Device Revision	(DEV_REV of RB)		
		7	DD Revision	(DD_REV of RB)		
		8	Software Revision	(SOFT_REV of RB)		
		9	Software Name	ORIGINAL		
		10	Domain Name	(Device name)		
440	DOMAIN					Read/write: prohibited Get-OD: permitted

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A7.10 Comments on System/Network Management VFD Parameters Relating to Software Download

IMPORTANT

Do not turn off the power to a field device immediately after changing parameter settings. Data writing actions to the EEPROM are dual redandant to ensure reliability. If the power is turned off within 60 seconds after setup, the parameters may revert to the previous settings.

(1) DWNLD_PROPERTY

Sub Index	Element	Size (Bytes)	Description
1	Download Class	1	Indicates the download class. 1: Class 1
2	Write Rsp Returned For ACTIVATE	1	Indicates whether a write response is returned to the ACTIVATE command. 1: Write Response Returned
3	Write Rsp Returned For PREPARE	1	Indicates whether a write response is returned to the PREPARE command. 1: Write Response Returned
4	Reserved	1	(Reserved)
5	ReadyForDwnld Delay Secs	2	Indicates the maximum delay after receipt of the PREPARE_FOR_DWNLD command to proceed to transition from DWNLD_NOT_READY to DWNLD_READY.
6	Activation Delay Secs	2	Indicates the maximum delay after receipt of the ACTIVATE command to proceed to transition from DWNLD_OK to DWNLD_NOT_READY.

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(2) DOMAIN_DESCRIPTOR

Sub Index	Element	Size (Bytes)	Description
1	Command	1	Reads/writes software download commands. 1: PREPARE_FOR_DWNLD (instruction of download preparation) 2: ACTIVATE (activation instruction) 3: CANCEL_DWNLD (instruction of download cancellation)
2	State	1	Indicates the current download status. 1: DWNLD_NOT_READY (download not ready) 2: DWNLD_PREPARING (download under preparation) 3: DWNLD_READY (ready for download) 4: DWNLD_OK (download complete) 5: DOWNLOADING (download underway) 6: CHECKSUM_FAIL (not used in this product) 7: FMS_DOWNLOAD_FAIL (failure during download) 8: DWNLD_INCOMPLETE (download error detected at restart) 9: VCR_FAIL (not used in this product) 10: OTHER (download error other than 6 and 7 detected)
3	Error Code	2	Indicates the error during a download and activation. 0: success, configuration retained (download successfully completed) 32768 - 65535: Download error (See Table 4 for error codes.)
4	Download Domain Index	4	Indicates the index number of the domain for software downloading.
5	Download Domain Header Index	4	Indicates the index number of the domain header to which the download is performing.
6	Activated Domain Header Index	4	Indicates the index numbers of the domain header currently running.
7	Domain Name	8	Indicates the domain name. With this product, Domain Name indicates the field device name.

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(3) DOMAIN_HEADER

Sub Index	Element	Size (Bytes)	Description
1	Header Version Number	2	Indicates the version number of the header.
2	Header Size	2	Indicates the header size.
3	Manufacturer ID	6	Indicates the value of resource block's MANUFAC_ID (manufacturer ID) as character string data.
4	Device Family	4	Indicates the device family. With this product, Device Family indicates the value of resource block's DEV_TYPE as character string data.
5	Device Type	4	Indicates the value of resource block's DEV_TYPE as character string data.
6	Device Revision	1	Indicates the value of resource block's DEV_REV.
7	DD Revision	1	Indicates the value of resource block's DD_REV.
8	Software Revision	8	Indicates the value of resource block's SOFT_REV.
9	Software Name	8	Indicates the attribute of the binary file. With this product, Software Name indicates either of the following: "ORIGINAL" followed by one space: Original file "UPDATE" followed by two spaces: Update file
10	Domain Name	8	Indicates the domain name. With this product, Domain Name indicates the field device name.

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APPENDIX 8. ADVANCED DIAGNOSTICS

A8.1 Multi-sensing Process Monitoring

Multi-sensing process monitoring function (option code: /DG1) provides the advanced diagnostics to detect the abnormal conditions in process environment such as an impulse line etc. by using the EJX multi-sensing technology and its unique algorithm. There are following two functions.

■ Impulse Line Blockage Detection (ILBD)

The fluctuation change of differential pressure and static pressure is monitored by a silicone resonant sensor and detects a potential blockage condition. The differential pressure transmitter provides also a result of which pressure-side was plugged.

■ Heat Trace Monitoring

The flange temperature is calculated by two temperature sensors built in the EJX. The temperature change enables to detect the heat trace breakage or the abnormal temperature due to the failure.

A8.2 Impulse Line Blockage Detection (ILBD)

ILBD is carried out by using statistical analysis based on the measured values of process fluctuations that exist in a fluid. An alarm on the EJX LCD display or an analog alert is generated if blockage reaches a certain level. EJX provides the following results as blockage detection.

(1) A Blocking and B Blocking
These are blockage detections based on the fluctuation value change of differential pressure/ pressure. With a differential pressure transmitter, each result indicates that both or single side is plugged.

(2) L Side Blocking
It is a low-pressur-side blockage detection based on the change of VALUE_BLKF* or low-pressure-side fluctuation value.

(3) H Side Blocking
It is a high-pressure-side blockage detection based on the change of VALUE_BLKF* or high-pressure-side fluctuation.

*: VALUE_BIKF indicates blockage degree characterized by a comparison of the high- and low-pressure-side fluctuation values. For the details, refer to A8.2.1.

IMPORTANT

- The pressure fluctuation amplitude in fluids must be sufficiently large for blockages to be detected.
- If the pressure fluctuation amplitude is too low for a reference value to be obtained, blockages detection operation cannot be performed with an alarm that the reference value is invalid.
- The pressure fluctuation amplitude may change due to other causes unrelated with a blockage according to process condition. In above case, a false alarm of an impulse line blockage may be generated. Before taking action in response to a blockage alarm, you need to consider the plant operating conditions.

■ Notes for Pressure or Level measurement

With pressure or level measurement, the pressure fluctuation amplitude may reduce especially for the following cases.

● Pressure Measurement

- Operational pressure is near outside diagnostic range.
- Even though pressure is constant, the flow decreases than that under normal condition.
- A source of pressure fluctuation (pump, compressor, blower, etc.) is shut down. As a result, the pressure fluctuation amplitude decreases.

● Level Measurement

- A transmitter is used to measure tank level and the flow of fluid into or out of the tank comes to a stop.
- The agitator in the tank is shut down.
- A source of pressure variation (a compressor, etc.) that controls the internal pressure of a sealed (closed) tank is shut down.

Before taking action in response to a blockage alarm, you need to consider the plant operating conditions.

■ Functional block diagram

The figure below shows the functional block diagram of ILBD, which is performed in the SENSOR Transducer block.

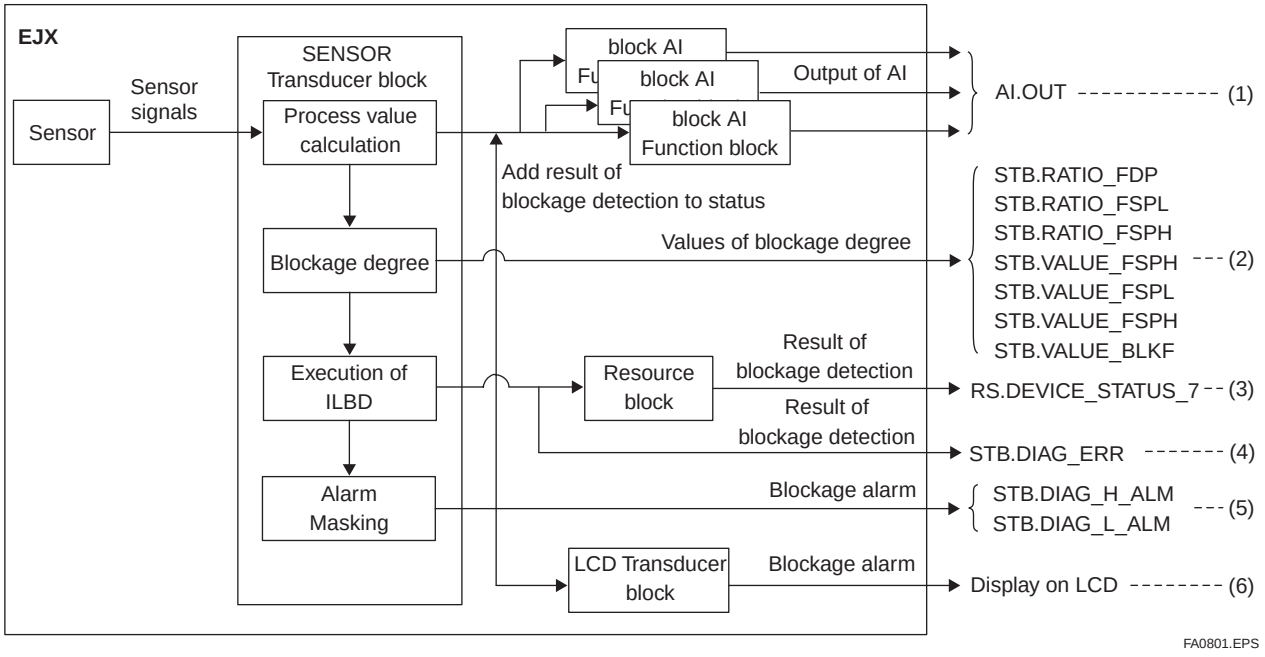

Figure A8.1 Functional Block Diagram of ILBD

The following outputs are given for the ILBD results.

Table A8.1 List of Outputs for ILBD

#	OUTPUT		Remarks
	Parameter name	Block	
(1)	OUT	AI function block	The result of blockage detection can be set to “UNCERTAIN: Non Specific” if DIAG_OPTION has been set to indicate the alarm status.
(2)	RATIO_FDP	SENSOR Transuducer Block	Parameters based on the fluctuation value and blockage degree [**COMP_FLG**: Non-Compensation] $\mathbf{RATIO\_FDP} = \sqrt{\frac{\mathbf{VALUE\_FDP}}{\mathbf{REFERENCE\_FDP}}}$ [**COMP_FLG**: Compensation] $\mathbf{RATIO\_FDP} = \sqrt{\frac{\mathbf{VALUE\_FDP}}{\mathbf{REFERENCE\_FDP}}} \times \left\lvert\frac{\mathbf{REFERENCE\_DPAVG}}{\mathbf{VALUE\_DPAVG}}\right\rvert$
	RATIO_FSPL		$\mathbf{RATIO\_FSPL} = \sqrt{\frac{\mathbf{VALUE\_FSPL}}{\mathbf{REFERENCE\_FSPL}}}$
	RATIO_FSPH		$\mathbf{RATIO\_FSPH} = \sqrt{\frac{\mathbf{VALUE\_FSPH}}{\mathbf{REFERENCE\_FSPH}}}$
	VALUE_BLKF		Blockage degree characterized in comparison of high-pressure side and low-pressure side pressure fluctuation value
	VALUE_FDP		Average value of the sum of squares of differential pressure fluctuations
	VALUE_FSPL		Average value of the sum of squares of low-pressure side static pressure fluctuation
	VALUE_FSPH		Average value of the sum of squares of high-pressure side static pressure fluctuation
(3)	DEVICE_STATUS_7	Resource block	When an impulse line blockage is detected, the result of the blockage detection (alarm status) is indicated.
(4)	DIAG_ERR	SENSOR Transducer block	When an impulse line blockage is detected, the results of the blockage detection (alarm status) are indicated.
(5)	DIAG_H_ALM	SENSOR Transducer block	When an impulse line blockage is detected, an alert is generated by divided into high- and low-pressure sides.
	DIAG_L_ALM		
(6)	Display on LCD		When impulse line blockage is detected, an alarm status is displayed on LCD.

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A8.2.1 Blockage Detection

■ DIAG_LIM

When the parameter based on pressure fluctuation exceeds the preset value, EJX diagnoses an impulse line as blockage and gives an alarm. The threshold values are set to DIAG_LIM [1] to [10] in the SENSOR Transducer block.

TableA8.2 shows the default values at the factory setting, which are different according to the model.

NOTE

When ILBD is performed for the first time, use the default value. If the pressure fluctuation amplitude is low or a false alarm is often generated after ILBD is performed, change the values of DIAG_LIM according to the procedure described in A8.2.10.

DIAG_LIM

#	Parameter	Threshold value
[1]	fdpmax	Threshold to detect “A Blocking” by using **RATIO_FDP**
[2]	fdpmin	Threshold to detect “B Blocking” by using **RATIO_FDP**
[3]	fsplmax	Threshold to detect “Large Fluctuation of Low Side” by using **RATIO_FSPL**
[4]	fsplmin	Threshold to detect “Low Side Blocking” by using **RATIO_FSPL**
[5]	fsphmax	Threshold to detect “Large Fluctuation of High Side” by using **RATIO_FSPH**
[6]	fsphmin	Threshold to detect “High Side Blocking” by using **RATIO_FSPH**
[7]	blkfmax	Threshold to detect “High Side Blocking” by using **VALUE_BLKF**
[8]	blkfmin	Threshold to detect “Low Side Blocking” by using **VALUE_BLKF**
[9]	dpavgmax	Threshold to detect “Outside Diagosis Range” by using **VALUE_DPAVG** and to detect “Invalid Ref xx” by using **REFERENCE_DPAVG**.
[10]	dpavgmin	Threshold to detect “Outside Diagosis Range” by using **VALUE_DPAVG** and to detect “Invalid Ref xx” by using **REFERENCE_DPAVG**.

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Table A8.2 Default Values of DIAG_LIM

#	Parameter	Multivariable transmitter
		EJX910A / EJX930A
[1]	fdpmax	3
[2]	fdpmin	0.3
[3]	fsplmax	5
[4]	fsplmin	0.5
[5]	fsphmax	5
[6]	fsphmin	0.5
[7]	blkfmax	0.6
[8]	blkfmin	-0.6
[9]	dpavgmax Note 1	1
[10]	dpavgmin Note 1	0.05

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Note 1: It indicates the threshold value for “Outside Diagnosis Range” (refer to A8.2.5).

■ A/B Blocking Detection

“A Blocking” and “B Blocking” indicates the result estimated from blockage degree based on the difference of the high- and low-pressure-side fluctuation values. RATIO_FDP, SQRT (VALUE_FDP / REFERENCE_FDP) is used to detect A/B Blocking. REFERENCE_FDP is the average value of the sum of squares of differential pressure fluctuations under normal condition. As the value of RATIO_FDP exceeds the value of DIAG_LIM [1], EJX gives basically an alarm of “A Blocking”. On the other hand, if this value is below the value of DIAG_LIM [2], EJX gives an alarm of “B Blocking. As a high- or low-pressure-side blockage progresses, VALUE_FDP increases. Therefore, “A Blocking” with a differential pressure transmitter indicates that a single-side impulse line is plugged for a differential pressure transmitter. As the both-side blockages progress simultaneously, VALUE_FDP decreases. Therefore, “B Blocking” with a differential pressure transmitter indicates that both-side impulse lines are plugged.

NOTE

A single-side impulse line blockage may generate “B blocking” under the condition where the fluctuation amplitude is much different between high- and low-pressure sides.

With a transmitter to measure pressure or tank level, “B Blocking” only is detected.

■ H/L Side Blocking Detection

EJX differential pressure transmitter enables to detect both-, a high-, or low-pressure-side blockage. The blockage degree characterized by a comparison of high-pressure side and low-pressure-side fluctuation values, VALUE_BLKF, is used to detect it. The value changes within a range of –1 to +1. As VALUE_BLKF approaches +1, the high-pressure-side blockage progresses. On the other hand, if it approaches -1, the low-pressure-side blockage progresses.

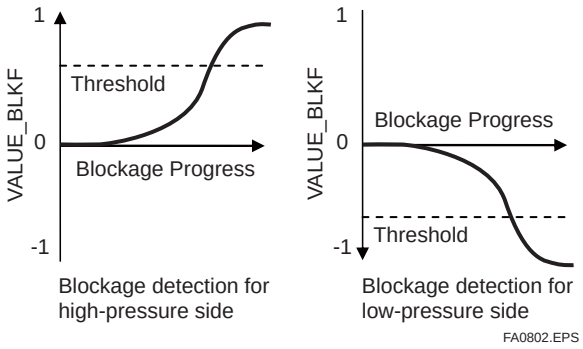

Figure A8.2 Relation between Blockage Progress and VALUE_BLKF

The each threshold value to detect the high- or low-pressure-side blockage is set to DIAG_LIM [7] or [8].

■ Low Side Blocking Detection

VALUE_BLKF is preferentially used to "Low Side Blocking" detection. If VALUE_BLKF cannot be used, RATIO_FSPL, SQRT (VALUE_FSPL / REFERENCE_FSPL) is used to "Low Side Blocking" detection. REFERENCE_FSPL is the average value of the sum of squares of low-pressure-side static pressure fluctuations under normal condition. As the value of RATIO_FSPL is below the value of DIAG_LIM [4], EJX gives an alarm of "Low Side Blocking". On the other hand, if this value exceeds the value of DIAG_LIM [3], EJX gives an alarm of “Large Fluctuation of Low Side”.

■ High Side Blocking Detection

VALUE_BLKF is preferentially used to "High Side Blocking" detection. If VALUE_BLKF cannot be used, RATIO_FSPH, SQRT (VALUE_FSPH / REFERENCE_FSPH) is used to "High Side Blocking" detection. REFERENCE_FSPH is the average value of the sum of squares of high-pressure-side static pressure fluctuations under normal condition.

As the value of RATIO_FSPH is below the value of DIAG_LIM [6], EJX gives an alarm of "High Side Blocking".

On the other hand, if this value exceeds the value of DIAG_LIM [5], EJX gives an alarm of “Large Fluctuation of High Side”.

■ Large Fluctuation Detection

When a pump or compressor starts, the large fluctuation is generated as process condition changes rapidly. This phenomenon affects process fluctuation measurement, so correct blockage detection is not performed.

If “Large fluctuation of Low Side” or “Large fluctuation of High Side” is detected, consider whether a blockage result is correct.

The threshold values to detect large fluctuation are set to DIAG_LIM [3] and [5].

Since these values are enough to detect large fluctuation, it is not almost necessary to change them.

A8.2.2 Combination of Reference Result and Blockage Detection

An EJX differential pressure transmitter can detect four modes of impulse line blockage: both-sides, high-pressure side, low-pressure side, and/or single-side when all the reference values are properly measured. However, the detectable alarm mode combination is limited when some of the reference values are invalid. The relation between the detectable blockage modes and reference value results are shown in the below figure.

NOTE

- REFERENCE_FDP must be larger than the specified level shown in Table A8.3 (refer A8.2.6). No blockage can be detected when VALUE_FDP is not large enough.
- The plausibility of blockage detection needs to be confirmed by blockage simulation test. The simulation test can be performed by the appropriate manifold operation (refer to A8.2.8).

[Differential pressure transmitter]

Fluctuation Parameters	Simulation Test	Available Blockage Detection
REFERENCE_FDP OK REFERENCE_FSPL OK REFERENCE_FSPH OK REFERENCE_BLKF OK	• Test for low-pressure side • Test for high-pressure side • Test for both-pressure sides	• B Blocking detection (by using RATIO_FDP) • Low side blockage detection (by using RATIO_FSPL) • High side blockage detection (by using RATIO_FSPH) • High/Low side blockage detection (by using VALUE_BLKF)
REFERENCE_FDP OK REFERENCE_FSPL OK REFERENCE_FSPH OK REFERENCE_BLKF NG	• Test for low-pressure side • Test for high-pressure side • Test for both-pressure sides	• A/B Blocking detection (by using RATIO_FDP) • Low Side Blocking detection (by using RATIO_FSPL) • High Side Blocking detection (by using RATIO_FSPH)
REFERENCE_FDP OK REFERENCE_FSPL NG REFERENCE_FSPH OK REFERENCE_BLKF NG	• Test for high-pressure side	• A Blocking detection (by using RATIO_FDP) • High Side Blocking detection (by using RATIO_FSPH)
REFERENCE_FDP OK REFERENCE_FSPL NG REFERENCE_FSPH NG REFERENCE_BLKF NG	• Test for both-pressure sides	• B Blocking detection (by using RATIO_FDP)

[Transmitter for gauge/absolute pressure and level measurement]

Fluctuation Parameters	Simulation Test	Available Blockage Detection
REFERENCE_FDP OK	• Test for high-pressure side	• B Blocking detection (by using RATIO_FDP)

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A8.2.3 Operating Parameters

■ DIAG_MODE

DIAG_MODE gives the directive for the ILBD operation. There are following three modes.

DIAG MODE

Index	Mode	Function
0	Stop	The blockage detection operation is stopped.
1	Calculation	The blockage detection operation is performed. Alarms are generated along with the result.
2	Reference	Reference values for the blockage detection are obtained and updated to the latest. After sampling reference values, this mode changes to "Calculation".

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When the blockage detection operation is performed, set “Calculation” to DIAG_MODE. “Stop” must be set when you change a threshold value or set an alarm. “Reference” is set in order to obtain the reference fluctuation values under the normal configuration.

■ DIAG_PERIOD

The values such as RATIO_FDP and BLKF are averaged based on several hundreds of pressure fluctuation values in constant time. DIAG_PERIOD defines the sampling time. The default value at the shipment is set to 180 seconds.

For the information on how to change the sampling period, refer to A8.2.10.

■ DIAG_COUNT

When the value as RATIO_FDP or BLKF exceeds the threshold value for several times in a row, it is estimated that the impulse line is plugged. DIAG_COUNT defines the number of times to estimate blockage detection.

If DIAG_COUNT is set to three times, an alarm is not generated at part ‘A’ in Figure A8.3. The reason is that only the first and second values exceeded consecutively the threshold.

When the value exceeds consecutively the threshold value three times, an alarm is generated (see part 'B' in Figure A8.3).

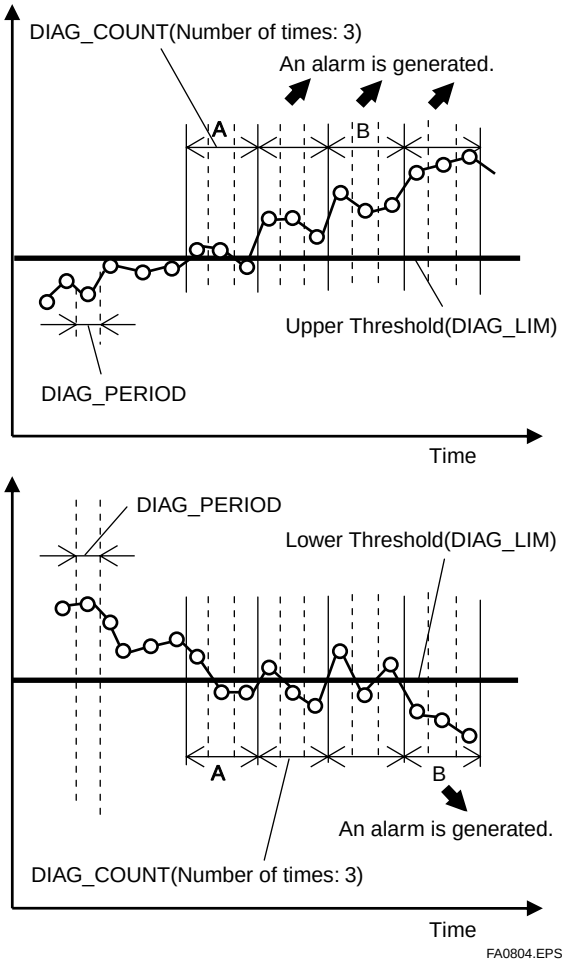

Figure A8.3 Relationship of DIAG_COUNT and Alarm

The number of detection to give an alarm is set for each blockage detection function. The default value at the shipment is set to three times.

If fluctuating around the threshold value, an alarm may be often generated. In this case, change the threshold value (DIAG_LIM) or the sampling time (DIAG_PERIOD) to enhance the accuracy of the blockage detection. Refer to A8.2.10.

A8.2.4 Operating Procedure

The basic flow of the ILBD operation is as follows.

1) Initial setting
2) Condition check
3) Start up
4) Perform the ILBD algorithm.

If an alarm is often generated or the process condition changed in the ILBD operation, do tuning, to change the alarm setting, or to reset the reference values.

Fill out the information to the checklist, at the process shown in below figure.

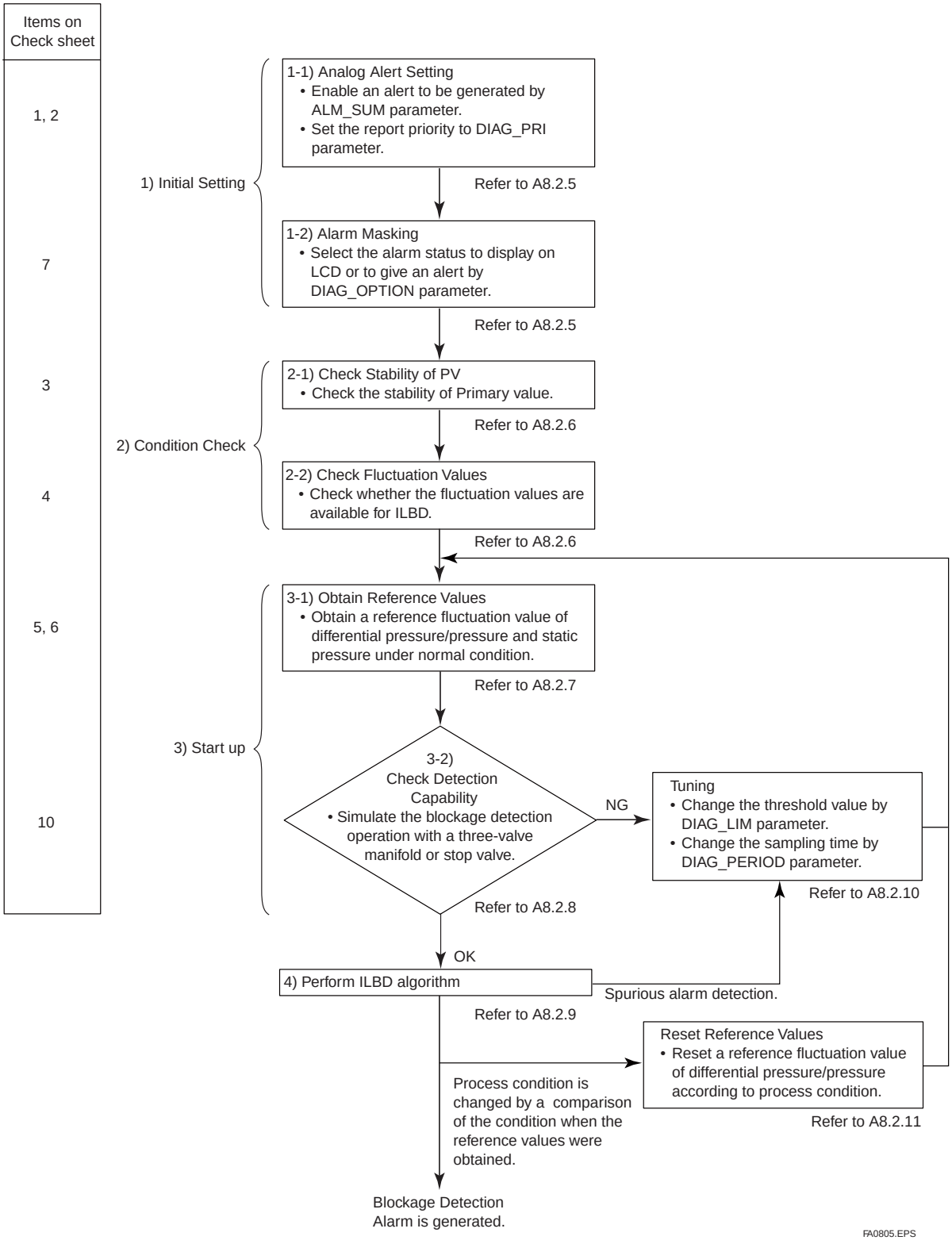
Items on Check sheet
1, 2
7
3
4
5, 6
10
1) Initial Setting
2) Condition Check
3) Start up
1-1) Analog Alert Setting
• Enable an alert to be generated by ALM_SUM parameter.
• Set the report priority to DIAG_PRI parameter.
Refer to A8.2.5
1-2) Alarm Masking
• Select the alarm status to display on LCD or to give an alert by DIAG_OPTION parameter.
Refer to A8.2.5
2-1) Check Stability of PV
• Check the stability of Primary value.
Refer to A8.2.6
2-2) Check Fluctuation Values
• Check whether the fluctuation values are available for ILBD.
Refer to A8.2.6
3-1) Obtain Reference Values
• Obtain a reference fluctuation value of differential pressure/pressure and static pressure under normal condition.
Refer to A8.2.7
3-2) Check Detection Capability
• Simulate the blockage detection operation with a three-valve manifold or stop valve.
NG
Tuning
• Change the threshold value by DIAG_LIM parameter.
• Change the sampling time by DIAG_PERIOD parameter.
Refer to A8.2.10
Refer to A8.2.8
OK
4) Perform ILBD algorithm
Spurious alarm detection.
Refer to A8.2.9
Reset Reference Values
• Reset a reference fluctuation value of differential pressure/pressure according to process condition.
Refer to A8.2.11
Process condition is changed by a comparison of the condition when the reference values were obtained.
Blockage Detection Alarm is generated.
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Figure A8.4 Flow Chart of ILBD Operation

A8.2.5 Alarm and Alert setting

The abnormal results, as the blockage detection and high/low flange temperature (heat trace monitoring) are given by an analog alert or the LCD display of alarm status. The analog alert or the LCD display of alarm status is set according to the flow shown in below figure.

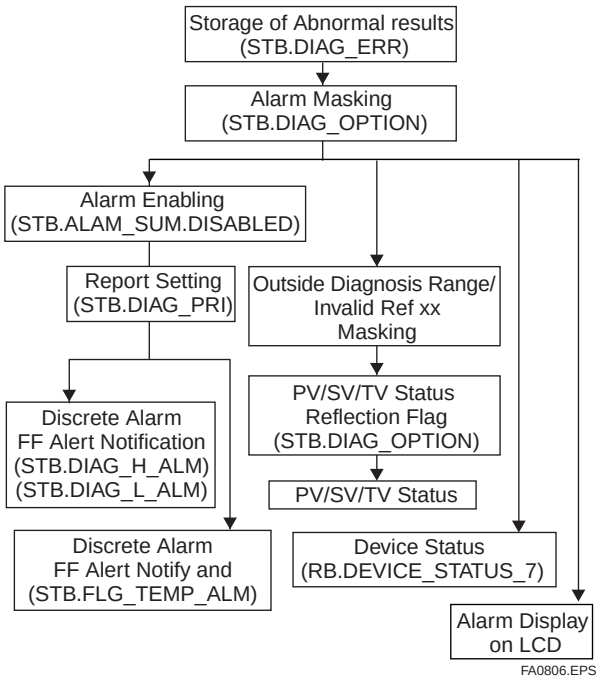

Figure A8.5 Alarm and Alert Setting

■ Alarm Status

When the algorithm of ILBD and Heat trace monitoring detect the abnormality, the result is stored in DIAG_ERR. The alarm status based on the detected abnormality is displayed to DIAG_ERR in the SENSOR Transducer block.

DIAG_ERR

Bit	Alarm status	DIAG_H_ALM	DIAG_L_ALM	FLG_TEMP_ALM
0	Not used.			
1	Not used.			
2	A Blocking	√	√	
3	Large Fluctuation of Low Side		√	
4	Large Fluctuation of High Side	√		
5	Low Side Blocking		√	
6	High Side Blocking	√		
7	B Blocking	√	√	
8	Invalid Ref BlkF	√	√	
9	Invalid Ref fSPh	√		
10	Invalid Ref fSPl		√	
11	Invalid Ref fDP	√	√	
12	Outside Diagnosis Range	√	√	
13	Flg Temp Low Alarm			√
14	Flg Temp High Alarm			√
15	Reflect Blockage to PV/SV/TV status			

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Note : The bit 13 and 14 are used for Heat trace monitorig function.

● Outside Diagnosis Range

1) dpavgmax

The dpavgmax, DIAG_LIM [9], is the upper limit of the diagnostic capability range. The limit value can be changed when DIAG_MODE is “Stop”.
VALUE_DPAVG indicates the ratio of the average of differential pressure to the EJX maximum span regarded as 1. When VALUE_DPAVG exceeds this limit, “Outside Diagnosis Range” is generated so that the blockage detection becomes impossible.

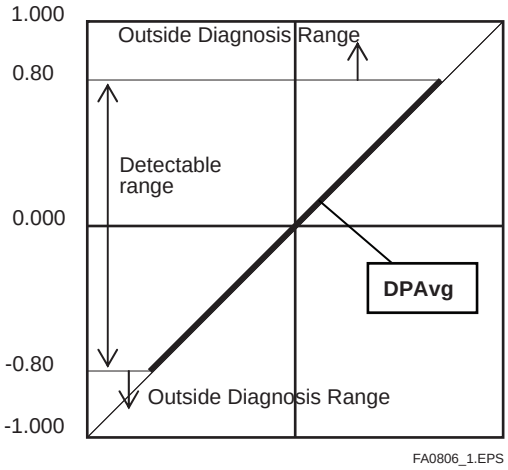
2) dpavgmin

The dpavgmin, DIAG_LIM [10], is the lower limit of the diagnostic capability range. The limit value can be changed when DIAG_MODE is “Stop”.
When VALUE_DPAVG is below this limit, “Outside Diagnosis Range” is generated so that the blockage detection becomes impossible.

<Example>
When the level range that can be measured by the transmitter with 100 kPa span is -80 to 80 kPa, the limits are set as follows.

• dpavgmax: 0.80

• dpavgmin: -0.80



● Invalid Ref BlkF, fSPh, fSPl, or fDP

This alarm indicates that the reference value under normal condition is invalid. If REFERENCE_BLKF is invalid, the blockage detection excluding VALUE_BLKF is carried out. If blockage detection function based on VALUE_BLKF is required, obtain the reference value again.

Also when REFERENCE_DPAVG is below DIAG_LIM [10] or exceeds DIAG_LIM [9], all reference value becomes invalid so that “Invalid Ref fDP”, “Invalid Ref fSPl”, “Invalid Ref fSPh”, and “Invalid Ref BlkF” are generated.

■ Alarm Masking

● DIAG_OPTION

The alarms linked to an analog alert and LCD display are selected by DIAG_OPTION in the SENSOR Transducer block. The BIT of DIAG_OPTION is corresponding to that of DIAG_ERR.

To link the alarm to an analog alert and LCD display, follow the procedure below.

1) Set "Stop" to DIAG_MODE.
2) Check each checkbox of the alarm, which is selectable from bit 2 to bit 14.

Note: The bit 13 and 14 are used for Heat trace monitoring function.
Set to “Calculation” after setting the parameters.

■ Analog Alert Setting

● Link to DIAG_H_ALM and DIAG_L_ALM

DIAG_H_ALM and DIAG_L_ALM enable to indicate the alarm status separately divided into the high- and low-pressure-side alert. The factory setting is not enabled to display them.

Enable to display the alarm status to DIAG_H_ALM and DIAG_L_ALM according to the following procedure.

1) Set "Stop" to DIAG_MODE.
2) Uncheck the checkbox of "Diag Alm Disabled”, which is corresponding to bit 8, in ALARM_SUM.

Note: Set to “Calculation” after setting the parameters.

● Report Setting

DIAG_PRI in SENSOR Transducer block defines the priority to transfer the analog alert to the host. The alert is generated according to the priority when interfering in other EJX alerts.

DIAG_PRI

Bit	Description
0	An alert is not generated.
1	An alert does not be reported to the host.
2	Disabled
3-7	ADVISORY
8-15	CRITICAL

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The default value at the factory setting is set to 1.

Set the priority according to the following procedure.

1) Set "Stop" to DIAG_MODE.
2) Enter the value to DIAG_PRI in the number of 3 to 15.

Note: The setting of the highest priority is 15.
Set to “Calculation” after setting the parameters.

■ Alarm Display on LCD

If the ILBD algorithm detects the abnormality, the content of the detected result is displayed with “AL.88” or “AL.89” on the LCD. “AL.88” indicates that condition is not applicable for the abnormality detection and “AL.89” indicates the abnormality is detected.

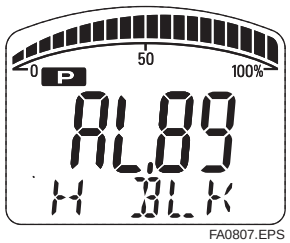

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Figure A8.6 Display Example of High Side Blocking

The alarm display on LCD regarding ILBD is described in Table 8.12 of the section 8.

■ Reflect Blockage to PV/SV/TV Status

“Reflect Blockage to PV/SV/TV Status” corresponding to bit 15 in DIAG_OPTION is used to link the alarm to the OUT signal status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE.

When the ILBD algorithm detects the abnormality, each signal status becomes “UNCERTAIN: Non Specific”.

The alarm is linked to the signal status of PV, SV and TV, according to the following procedure.

1) Set "Stop" to DIAG_MODE.
2) Check the checkbox of “Availability for the Status” of DIAG_OPTION.

Note: Set to “Calculation” after setting the parameters.

NOTE

The alarms of "Invalid Ref xx", "Outside Diagnosis Range" do not link to the signal status of PV, SV, and TV.

A8.2.6 Condition Check

After the EJX differential pressure/pressure transmitter was installed, it is necessary to confirm that the Primary Value (PV) is stable under the normal operating condition and that fluctuation amplitude under the normal operating condition is large enough to detect the blockage.

■ Stability of Primary Value

1) Observe the value change of PRIMARY_VALUE under the normal operating condition for 10 minutes.
2) Confirm the value change is less than 10%.

If the value change is more than 10%, the error influences pressure fluctuation value so that the blockage detection becomes Unreliable. You need to consider the plant operating conditions.

■ Fluctuation Value

NOTE

The blockage detection may not be carried out correctly when pressure fluctuation amplitude especially with the pressure and level measurement, is small.

Confirm that each value of VALUE_FDP, VALUE_FSPL, VALUE_FSPH, and VALUE_BLKF is more than the value specified in the below table.

Table A8.3 Requiremnents to apply ILBD

	Condition
VALUE_FDP	7×10^{-10} or more
VALUE_FSPL	1×10^{-10} or more
VALUE_FSPH	1×10^{-10} or more
VALUE_BLKF	-0.5 to 0.5

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● VALUE_FDP is not enough.

No blockage can be detected if VALUE_FDP is not larger than the specified value.

● Only VALUE_FDP is enough.

“A Blocking” or “B Blocking” can be detected if VALUE_FSPL and VALUE_FSPH are not larger than specified values.

● **VALUE_FDP and VALUE_FSPL are enough.**

"High Side Blocking" and "Large Fluctuation of High Side" can not be detected if VALUE_FSPH is not larger than specified value.

● **VALUE_FDP and VALUE_FSPH are enough.**

"Low Side Blocking" and "Large Fluctuation of Low Side" can not be detected if VALUE_FSPL is not larger than specified value.

● **VALUE_FDP, VALUE_FSPL and VALUE_FSPH are enough**

All alarm modes ca be detected even if VALUE_BLKF is not within the specified values.

A8.2.7 Obtain Reference Values

The pressure fluctuation values are reduced when the impulse line is plugged. Therefore, the reference value is required to determine the degree of reduction

IMPORTANT

- If the impulse line is about to be plugged at the time when a reference value is obtained, blockages cannot be detected accurately. The impulse lines on both the high-pressure and low-pressure sides need to be cleaned before a reference value is obtained.
- All air bubbles need to be adequately purged before a reference value is obtained.
- Reference values must be obtained under operating condition.
- Do not obtain the reference values when the BLOCK_MODE of SENSOR Transducer is OOS. If carried out, an alarm of "Invalid Ref xx" is generated.

■ Start of Sampling

The sampling of reference value is carried out for 180 sec, which is the default value set to DIAG_PERIOD.

1) Confirm that the sampling period (DIAG_PERIOD) is set to 180 sec.
2) Set "Reference" to DIAG_MODE. The sampling starts soon after the setting.

IMPORTANT

- For the each parameter, the one value is given. If "Reference" is set to DIAG_MODE again, the value is updated and overwritten.
- If the power supply is shut down during the sampling, DIAG_MODE becomes "Stop". Set "Reference" to DIAG_MODE in order to carry out the sampling again.

■ End of Sampling

After about 180 sec, the sampling automatically finishes. The "Reference" setting of DIAG_MODE changes automatically to "Calculation" and the termination time is recorded to REFERENCE_TIME.

1) Confirm that the setting of DIAG_MODE changes to "Calculation".
2) Check the termination time recorded into REFERENCE_TIME.

■ Reference Values

Confirm the latest values are obtained into the following parameters.

- REFERENCE_FDP
- REFERENCE_FSPL
- REFERENCE_FSPH
- REFERENCE_BLKF
- REFERENCE_DPAVG

■ Invalid Ref BlkF, fSPh, fSPl, or fDP

When the enough reference fluctuation value is not obtained, an alarm of Invalid Reference value for each parameter is generated and also the part of ILBD function related to the Invalid Ref BlkF, fSPh, fSPl, or fDP is not carried out.

Confirm the alarm of Invalid Ref BlkF, fSPh, fSPl, or fDP is not displayed in DIAG_ERR.

If an alarm of Invalid Reference value is generated, consider the process condition or obtain the reference fluctuation values again.

NOTE

Even if an alarm of Invalid Ref BlkF, fSPh, fSPl, or fDP is generated, "Calculation" in DIAG_MODE is kept.

A8.2.8 Capability Test of Blockage Detection Operation

Before performing the ILBD operation, check the capability of the blockage detection operation. The simulation test is performed by closing motion of a three-valve manifold or stop valve. When simulated blockage occurs, confirm that an alarm is generated.

NOTE

The fluctuation amplitude of atmospheric pressure is nearly zero with pressure or level measurement. In such case, simulate the blockage detection by closing the valve where the fluctuation existed.

■ Simulation of High-pressure-side Blockage

1) Close the high-pressure-side valve.
2) Confirm the value of PRIMARY_VALUE is stable. If unstable, open valve a little.
3) Set “Calculation” to DIAG_MODE so as to start blockage detection operation.
4) Check that an alarm of “High Side Blocking” is generated after the time that consists of DIAG_PERIOD and DIAG_COUNT passed.
5) Check also the operation of the analog alert if an analog alert is set.
6) Open the valve completely and check that there are no alarms.

■ Simulation of Low-pressure-side Blockage

1) Close the low-pressure-side valve.
2) Confirm the value of PRIMARY_VALUE is stable. If unstable, open valve a little.
3) Set “Calculation” to DIAG_MODE so as to start blockage detection operation.
4) Check that an alarm of “Low Side Blocking” is generated after the time that consists of DIAG_PERIOD and DIAG_COUNT passed.
5) Check also the operation of the analog alert if an analog alert is set.
6) Open the valve completely and check that there are no alarms.

■ Simulation of Both-pressure-side Blockage

1) Close the both-pressure-side valves.
2) Confirm the value of PRIMARY_VALUE is stable. If unstable, open valve a little.
3) Set “Calculation” to DIAG_MODE so as to start blockage detection operation.
4) Check that an alarm of “B Blocking” is generated after the time that consists of DIAG_PERIOD and DIAG_COUNT passed.
5) Check also the operation of the analog alert if an analog alert is set.
6) Open the valves completely and check that there are no alarms.

A8.2.9 Start ILBD Operation

If process condition and capability to detect a blockage are confirmed, the ILBD operation can be started according to the following procedure.

1) Check the value of sampling period (DIAG_PERIOD).
2) Check the number of times that detect the blockage consecutively in order to give an alarm (DIAG_COUNT). The default value at the shipment is set to 3 times.
3) Set “Calculation” status to DIAG_MODE.
   If the reference value has not yet been obtained, set “Reference” to DIAG_MODE. After obtained the reference values, the ILBD starts automatically. At the same time, DIAG_MODE changes automatically from “Reference” to “Calculation”.

A8.2.10 Tuning

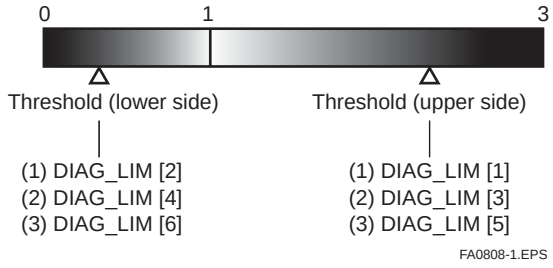
When the pressure fluctuation amplitude in fluids is not sufficiently large or an alarm is often generated according to the process condition, tune up by changing the threshold for the blockage detection (DIAG_LIM) or the sampling period (DIAG_PERIOD) to enhance the accuracy of the blockage detection

The ILBD operation must be stopped to tune up. Set “Stop” to DIAG_MODE.

■ Threshold Value

The figure below shows the image of tuning effect with a monochrome bar.

(a) The tuning image of the threshold values for
(1) RATIO_FDP Sqrt (VALUE_FDP/REFERENCE_FDP),
(2) RATIO_FSPL Sqrt (VALUE_FSPL/REFERENCE_FSPL),
(3) RATIO_FSPH Sqrt (VALUE_FSPH/REFERENCE_FSPH)



(b) The tuning image of the threshold values for
(4) Sqrt (VALUE_BLKF/REFERENCE_BLKF)

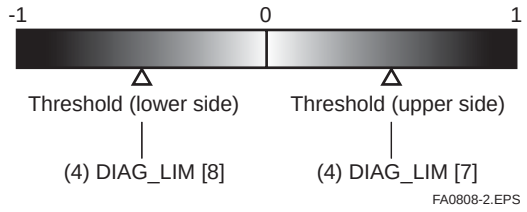


Figure A8.7 Tuning Image of Threshold Value

● Move the threshold toward the white.

- It becomes increasingly likely to give an alarm due to the disturbance from environment change.
- If flow/differential pressure is below DIAG_LIM [10] or exceeds DIAG_LIM [9], pressure fluctuation is likely too small or too large to detect the blockage.

● Move the threshold toward the black.

- It enables to be insusceptible to disturbance such as environment change and to detect the blockage easier.
- It becomes giving an alarm of the blockage after the blockage has been progressed.

The default values at the factory setting are the values of DIAG_LIM [1] to [8] shown in Table A8. 2.

Change the threshold value to solve your problem according to the above image

(1) Set “Stop” to DIAG_MODE.
(2) Change the unsuitable value of DIAG_LIM corresponding to the each blockage detection.

Note: Set to “Calculation” after setting the parameters.

DIAG_LIM

#	Parameter	Threshold value
[1]	fdpmax	Threshold to detect “A Blocking” by using **RATIO_FDP**
[2]	fdpmin	Threshold to detect “B Blocking” by using **RATIO_FDP**
[3]	fsplmax	Threshold to detect “Large Fluctuation of Low Side” by using **RATIO_FSPL**
[4]	fsplmin	Threshold to detect “Low Side Blocking” by using **RATIO_FSPL**
[5]	fsphmax	Threshold to detect “Large Fluctuation of High Side” by using **RATIO_FSPH**
[6]	fsphmin	Threshold to detect “High Side Blocking” by using **RATIO_FSPH**
[7]	blkfmax	Threshold to detect “High Side Blocking” by using **VALUE_BLKF**
[8]	blkfmin	Threshold to detect “Low Side Blocking” by using **VALUE_BLKF**

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■ Sampling Period

If fluctuating around the threshold value, an alarm may be often generated. When the above phenomenon happens, the sampling time (DIAG_PERIOD) can be changed as as to enhance the accuracy of the blockage detection.

The longer the sampling time, better the expected accuracy.

(1) Set “Stop” to DIAG_MODE.
(2) Enter the value to DIAG_PERIOD within the range of 20 to 65535 (sec).

Note: Set to “Calculation” after setting the parameters.

Also, the accuracy can be improved by increasing the number of DIAG_COUNT.

■ ILBD Range Setting

When the VALUE_DPAVG is less than the value of the DIAG_LIM [10] or exceeds the value of DIAG_LIM [9] shown in Table A8. 2, EJX gives an alarm of “Outside Diagnosis Range”.

If flow/differential pressure is less than the default threshold value of DIAG_LIM [10], pressure fluctuation is not large enough to detect the blockage. To prevent the fault blockage detection, the threshold value should be changed to larger value.

(1) Set “Stop” to DIAG_MODE.
(2) Enter the value to DIAG_LIM [10].

Note: Set to “Calculation” after setting the parameters.

■ COMP_FLG

When “Compensation” is selected in COMP_FLG, RATIO_FDP is compensated by following formula and used as treatable monitoring value, CRATIO_FDP.

$$\text{CRATIO\_FDP} = \sqrt{\frac{\text{VALUE\_FDP}}{\text{REFERENCE\_FDP}}} \times \left| \frac{\text{REFERENCE\_DPAVG}}{\text{VALUE\_DPAVG}} \right|$$

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On the other hand, if the compensation is not necessary, “Non-compensation” is selected in COMP_FLG and RATIO_FDP is used as NRATIO_FDP.

$$\text{NRATIO\_FDP} = \sqrt{\frac{\text{VALUE\_FDP}}{\text{REFERENCE\_FDP}}}$$

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A8.2.11 Reset of Reference Value

When there are large flow change or the change of fluid under the measured process conditions, obtain the reference value again.

If flow change by a comparison of the reference value is ±25% or more, you need to obtain the reference value again.

A8.2.12 ILBD Parameter Lists

All the ILBD parameters belong to the SENSOR Transducer block.

Note: The Write Mode column contains the modes in which each parameter is write enabled.
O/S: Write enabled in O/S mode.
MAN: Write enabled in Man mode and O/S mode.
AUTO: Write enabled in Auto mode, Man mode, and O/S mode.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
83	2083	DIAG_MODE	Stop (0)	AUTO	Select the function mode for the ILBD. Stop (0): The blockage detection is stopped. Calculation (1): The blockage detection is carried out. The alarms are generated along with the detected result. Reference (2): The reference values are obtained and the update values are overwritten. After setting, this mode changes automatically to Calculation (1).
84	2084	DIAG_PERIOD	180 (sec)	AUTO	Set the data acquisition period for ILBD within the range of 20 to 65535 (sec). Writable only when DIAG_MODE is Stop(0). If the process fluctuation values are unsteady, change this value to the longer to enhance the accuracy of the blockage detection.
85	2085	DIAG_PRI	1	AUTO	Set alert (DIAG_H_ALM and DIAG_L_ALM) priority for ILBD. Writable only when DIAG_MODE is Stop(0).
86	2086	DIAG_ERR	0x0000	–	The following ILBD results are shown. • A Blocking (bit 2) • Large Fluctuation of Low Side (bit 3) • Large Fluctuation of High Side (bit 4) • Low Side Blocking (bit 5) • High Side Blocking (bit 6) • B Blocking (bit 7) • Invalid Ref BlkF (bit 8) • Invalid Ref fSPh (bit 9) • Invalid Ref fSPl (bit 10) • Invalid Ref fDP (bit 11) • Outside Diagnosis Range (bit 12) • Flg Temp Low Alarm (bit 13) • Flg Temp High Alarm (bit 14) Bit 15 is used to link the alarm to status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE.
87	2087	DIAG_H_ALM		–	Alerts for high-pressure side are indicated. • A Blocking • B Blocking • Large Fluctuation of High Side • High Side Blocking • Invalid Reference value (BlkF, fSPh, or fDP) • Outside Diagnosis Range

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
88	2088	DIAG_L_ALM		–	Alerts for low-pressure side blockage are indicated due to the following factors. • A Blocking • B Blocking • Large Fluctuation of Low Side • Low Side Blocking • Invalid Reference value (BlkF, fSPl, or fDP) • Outside Diagnosis Range
89	2089	DIAG_OPTION	0x8FC	AUTO	The alarm status linked to an analog alert and LCD display is selected by DIAG_OPTION in the SENSOR Transducer block. The alarm selected in DIAG_OPTION is corresponding to bit of DIAG_ERR. BIT 15 is used to link the alarm to the status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE. If set to 1, the signal status becomes “UNCERTAIN: Non Specific” when the ILBD algorithm detects the abnormality. Writable only when DIAG_MODE is Stop(0).
90	2090	REF_LIM _FDPMIN	7.0E-10	AUTO	Lower limit to judge whether **REFERENCE_FDP** is available for ILBD operation. Writable only when Diag Mode is Stop(0).
91	2091	REF_LIM _FSPMIN	1.0E-10	AUTO	Lower limit to judge whether **REFERENCE_FSPL** and REFERENCE_FSPH are available for ILBD operation. Writable only when Diag Mode is Stop(0).
92	2092	REF_LIM _BLKFMAX	0.5	AUTO	Upper limit to judge whether **REFERENCE_BLKF** is available for ILBD operation. Writable only when Diag Mode is Stop(0).
93	2093	COMP_FLG	0 (Compensation)	AUTO	Whether RATIO_FDP is referred by CRATIO_FDP or NRATIO_FDP is selected. • Compensation(0) • Non-Compensation(1)
94	2094	DIAG_LIM	Refer to Table A8. 2.	AUTO	Set the ten threshold value for ILBD. [1] Upper limit to detect “A Blocking” [2] Lower limit to detect “B Blocking” [3] Upper limit to detect “Large Fluctuation of Low Side” [4] Lower limit to detect “Low Side Blocking” [5] Upper limit to detect “Large Fluctuation of High Side” [6] Lower limit to detect “High Side Blocking” [7] Upper limit to detect “High Side Blocking” by using VALUE_BLKF [8] Lower limit to detect “Low Side Blocking” by using VALUE_BLKF [9] Upper limit to detect “Outside Diagnosis Range” [10] Lower limit to detect “Outside Diagnosis Range” Writable only when DIAG_MODE is Stop(0).
95	2095	DIAG_COUNT	3	AUTO	When the statistical value such as VALUE_FDP and VALUE_BLKF exceeds consecutively the threshold by number of times preset to this parameter, it is estimated that the impulse line is plugged. Writable only when DIAG_MODE is Stop(0). If the process fluctuation values are unsteady, increase this numbers to enhance the accuracy of the blockage detection.

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Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
96	2096	REFERENCE _TIME	0x00000000	AUTO	The date and time when the reference values were obtained are automatically recorded when DIAG_MODE is set to Reference (2).
97	2097	REFERENCE _FDP	0x00, 0	AUTO	The reference value of VALUE_FDP obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
98	2098	REFERENCE _FSPL	0x00, 0	AUTO	The reference value of VALUE_FSPL obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
99	2099	REFERENCE _FSPH	0x00, 0	AUTO	The reference value of VALUE_FSPH obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
100	2100	REFERENCE _BLKF	0x00, 0	AUTO	VALUE_BLKF obtained under normal condition
101	2101	REFERENCE _DPAVG	0x00, 0	AUTO	The average value of differential pressure obtained at normal operating condition is automatically recorded when DIAG_MODE is set to Reference (2).
102	2102	VALUE_TIME		–	The date and time when the statistical values such as VALUE_FDP and VALUE_BLKF were calculated are recorded.
103	2103	VALUE_FDP		–	Average value of the sum of squares of differential pressure/pressure fluctuations
104	2104	VALUE_FSPL		–	Average value of the sum of squares of low-pressure side static pressure fluctuations
105	2105	VALUE_FSPH		–	The average value of the sum of squares of low-pressure side static pressure fluctuations
106	2106	VALUE_BLKF		–	Blockage degree characterized in comparison of high-pressure side and low-pressure side pressure fluctuation values
107	2107	VALUE_DPAVG		–	Ratio of the average of differential pressure/pressure to the maximum span of an EJX
108	2108	RATIO_FDP		–	CRATIO_FDP or NRATIO_FDP is used by COMP_FLG setting. VALUE_FDP decreases and this parameter is used to determine whether single or both side is plugged.
109	2109	RATIO_FSPL		–	SQRT (VALUE_FSPL/REFERENCE_FSPL). VALUE_FSPL decreases and this parameter is used to determine whether low-pressure-side is plugged.
110	2110	RATIO_FSPH		–	SQRT (VALUE_FSPH/REFERENCE_FSPH). VALUE_FSPH decreases and this parameter is used to determine whether high-pressure-side is plugged.
111	2111	CRATIO_FDP		–	RATIO_FDP is compensated by following formula and used as treatable monitoring value when the flow change is too large or small. CRATIO_FDP = Sqrt (VALUE_FDP/REFERENCE_FDP) X|REFERENCE_DPAVG / DPAVG)| When Compensation is selected in COMP_FLG, CRATIO_FDP is used as monitoring value.
112	2112	NRATIO_FDP		–	When Non-compensation is selected in COMP_FLG, NRATIO_FDP is used as monitoring value NRATIO_FDP = Sqrt (VALUE_FDP/REFERENCE_FDP)
113	2113	DIAG _APPLICABLE		–	After the reference value is obtained, the applicable blockage detection is displayed on this parameter.

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A8.2.13 Checklist

Fill out the below checklist according to the operation flow of the ILBD in order to keep the important information for the blockage detection.

Checklist (1/5)

No.	Items	Parameters	Result	Example
1	Enable Analog Alert to Be Generated. • Uncheck the checkbox of “Diag Alm Disable” in ALARM_SUM.	ALARM_SUM (Index: 2063) “Diag Alm Disable”		√
2	Priority Setting of Analog Alert • Enter a value of more than 3 to DIAG_PRI. (3 is recommended.)	DIAG_PRI (Index: 2085)		3
3	Stability of PRIMARY_VALUE (differential pressure/pressure) under normal condition • Check that the status of PRIMARY_VALUE is “GOOD”. • Check the maximum and minimum values of PRIMARY_VALUE.	Status		Good
		PRIMARY_VALUE (Index: 2014)	Max.: Min.:	Max.: 12.3kPa Min.: 12.1kPa
4	VALUE_FDP under normal condition • Check that the value of VALUE_FDP is more than 7×10^{-10}.	VALUE_FDP (Index: 2103)		√
5	Start to obtain Reference values • Set Reference to DIAG_MODE.	DIAG_MODE (Index: 2083)		√
6	End of Reference Value Sampling • Check that DIAG_MODE is “Calcuration”, after the time set to DIAG_PERIOD passed.	DIAG_MODE (Index: 2083)		√
7	Alarm setting • Record the status of Checkbox in DIAG_OPTION.	DIAG_OPTION (Index: 2089)		
		A Blocking	☐	☑
		Large Fluctuation of Low Side	☐	☑
		Large Fluctuation of High Side	☐	☑
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☑
		B Blocking	☐	☑
		Invalid Ref BlkF	☐	☑
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☑
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐

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Checklist (2/5)

No.	Items	Parameters	Result	Example
8	Alarm status • Check the alarm status shown in DIAG_ERR. • Check that the alarm status of “Outside Diagnosis Range” is not shown in DIAG_ERR.	DIAG_ERR (Index: 2086)		
		A Blocking	☐	☐
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☐
		High Side Blocking	☐	☐
		B Blocking	☐	☐
		Invalid Ref BlkF	☐	☑
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
9	ILBD parameters • Record the values of parameters for ILBD operation. • Check the status of parameters for ILBD operation. *: Record the value after checked that the status of each parameter is “GOOD”.	DIAG_PERIOD (Index: 2084)		180
		DIAG_LIM (Index: 2094)		
		DIAG_LIM [1]		3.000000
		DIAG_LIM [2]		0.300000
		DIAG_LIM [3]		5.000000
		DIAG_LIM [4]		0.500000
		DIAG_LIM [5]		5.000000
		DIAG_LIM [6]		0.500000
		DIAG_LIM [7]		0.600000
		DIAG_LIM [8]		-0.600000
		DIAG_LIM [9]		1.000000
		DIAG_LIM [10]		0.050000
		DIAG_COUNT (Index: 2095)		3
		REFERENCE_TIME (Index: 2096)		16:22:55.876 01/31/2008
		REFERENCE_FDP* (Index: 2097)		7.43245e-9
		REFERENCE_FSPL* (Index: 2098)		7.25765e-9
		REFERENCE_FSPH* (Index: 2099)		7.18374e-9
		REFERENCE_DPAVG* (Index: 2101)		5.364248
		VALUE_TIME (Index: 2102)		16:22:55.876 01/31/2008
		VALUE_FDP (Index: 2103) *		7.48562e-9
		VALUE_FSPL (Index: 2104) *		7.23277e-9
		VALUE_FSPH (Index: 2105) *		7.14085e-9
		VALUE_BLKF (Index: 2106) *		-0.287259
		VALUE_DPAVG (Index: 2107) *		0.055957

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Checklist (3/5)

Go to the following step according to the result of "Invalid Ref xx" shown in the DIAG_ERR of 8th check item.

DIAG_ERR (Index: F2086)				Check item
Invalid Ref fSPh	Invalid Ref fSPl	Invalid Ref fDP		
☐	☐	☐	→	10-a
☑	☑	☐	→	10-b

☑ : The alarm is generated.

☐ : The alarm is not generated.

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No.	Items	Parameters	Result	Example
10-a	Simulation of Blockage detection operation • High Side Blocking: 10-a-1 • Low Side Blocking: 10-a-2 • Both Side Blocking: 10-a-3			
10-a-1	High Side Blocking • Close the high-pressure side valve completely.			
	• Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2103)*		7.48562e-9
		VALUE_FSPL (Index: 2104) *		7.23277e-9
		VALUE_FSPH(Index: 2105) *		7.14085e-9
		VALUE_BLKF (Index: 2106)		-0.287259
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “A Blocking” and “High Side Blocking” are set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2089)		
		A Blocking	☐	☑
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☐
		High Side Blocking	☐	☑
		B Blocking	☐	☐
		Invalid Ref BlkF	☐	☐
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “High Side Blocking” is generated. • Check that the alarm of “Low Side Blocking” is not generated.	DIAG_ERR (Index: 2086)		
		High Side Blocking	☐	☑
		Low Side Blocking	☐	☐

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Checklist (4/5)

No.	Items	Parameters	Result	Example
10-a-2	Low Side Blocking • Close the low-pressure side valve completely.			
	• Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2103) *		7.48562e-9
		VALUE_FSPL (Index: 2104) *		7.23277e-9
		VALUE_FSPH (Index: 2105)		7.14085e-9
		VALUE_BLKF (Index: 2106) *		-0.287259
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “A Blocking” and “Low Side Blocking” are set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2089)		
		A Blocking	☐	☑
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☐
		B Blocking	☐	☐
		Invalid Ref BlkF	☐	☐
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “Low Side Blocking” is generated. • Check that the alarm of “High Side Blocking” is not generated.	DIAG_ERR (Index: 2086)		
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☐
10-a-3	Both Side Blocking • Close the both-pressure side valves completely.			
	• Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2103)		7.48562e-9
		VALUE_FSPL (Index: 2104)		7.23277e-9
		VALUE_FSPH (Index: 2105)		7.14085e-9
		VALUE_BLKF (Index: 2106)		-0.287259
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “High Side Blocking” , “Low Side Blocking” and “B Blocking” are set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2089)		
		A Blocking	☐	☐
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☑
		High Side Blocking	☐	☑
		B Blocking	☐	☑
		Invalid Ref BlkF	☐	☐
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☐
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “B Blocking” is generated.	DIAG_ERR (Index: 2086)		
		B Blocking	☐	☑

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Checklist (5/5)

No.	Items	Parameters	Result	Example
10-b	Simulation of Blockage detection operation • Close completely the valve for the side where the alarm of Invalid Reference Value is not generated.			
	For the case that the high-pressure-side valve is closed; • Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2103)		7.48562e-9
		VALUE_FSPH (Index: 2105)		7.14085e-9
	For the case that the low-pressure-side valve is closed; • Record the values of VALUE_# after the certain time, (DIAG_PERIOD × DIAG_COUNT), passed. *: Record the value after checked that the status is “GOOD”.	VALUE_FDP (Index: 2103)		7.48562e-9
		VALUE_FSPL (Index: 2104)		7.23277e-9
	• Record the status of Checkbox in DIAG_OPTION. • Check that the alarms status of “B Blocking” is set. Note: If the alarm of “Outside Diagnosis Range” is generated, the valve may be closed too much tightly. Open valve a little and record the updated status of the parameters.	DIAG_OPTION (Index: 2089)		
		A Blocking	☐	☐
		Large Fluctuation of Low Side	☐	☐
		Large Fluctuation of High Side	☐	☐
		Low Side Blocking	☐	☐
		High Side Blocking	☐	☐
		B Blocking	☐	☑
		Invalid Ref BlkF	☐	☑
		Invalid Ref fSPh	☐	☐
		Invalid Ref fSPl	☐	☑
		Invalid Ref fDP	☐	☐
		Outside Diagnosis Range	☐	☐
		Reflect Blockage to PV/SV/TV Status	☐	☐
	• Check that the alarm of “B Blocking” is generated.	DIAG_ERR (Index: 2086)		
		B Blocking	☐	☑

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A8.3 Heat Trace Monitoring

The EJX with Heat trace monitoring function calculates the flange temperature by using the two temperature sensors built in the EJX. An analog alert is generated if the temperature reached to the preset level.

The flange temperature is based on the following parameters and calculation formula.

[Parameters]

Parameter name	Explanation
CAP_TEMP_VAL (CT)	Measured capsule temperature value
AMP_TEMP_VAL (AT)	Measured amplifier temperature value
FLG_TEMP_VAL (FT)	Flange temperature value (Calculated value)
FLG_TEMP_COEFF (Cf)	Coefficient to calculate flange temperature
FLG_TEMP_H_LIM	Threshold to generate Flg Temp High Alarm
FLG_TEMP_L_LIM	Threshold to generate Flg Temp Low Alarm

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[Calculation formula]

$$FLG\_TEMP\_VAL(FT) = CT + C_f \times (CT - AT)$$

The FLG_TEMP_VAL (FT) is assigned to Process Value (PV) in the AI function block. If the flange temperature exceeds the value preset to the HI_LIM, LO_LIM, HI_HI_LIM, or LO_LO_LIM in the AI function block, an analog alert is generated.

NOTE

The flange temperature is calculated by the calculation formula assumed that the capsule part of EJX is heated up or kept warm by an electrical heater or steam. In the case of an atmosphere temperature or less, the difference of temperature of approximately 3 to 4 °C may occur because the amplifier temperature becomes higher than the capsule temperature.

A8.3.1 FLG_TEMP_COEF Setting

The value calculated according to the following procedure is set to the FLG_TEMP_COEFF.

- To enhance the calculation accuracy of the flange temperature, measure the actual flange temperature by using the temperature sensor etc.
- Calculate the ratio of the capsule temperature to the capsule temperature minus the amplifier temperature from the two temperature values measured by EJX.
- Derive the FLG_TEMP_COEFF from the measured flange temperature and the ratio of the capsule temperature to the amplifier temperature in accordance with the following calculation formula.

$$FLG\_TEMP\_COEFF(C_f) = \frac{(\text{Actual measured value of Flange temperature}) - CT}{CT - AT}$$

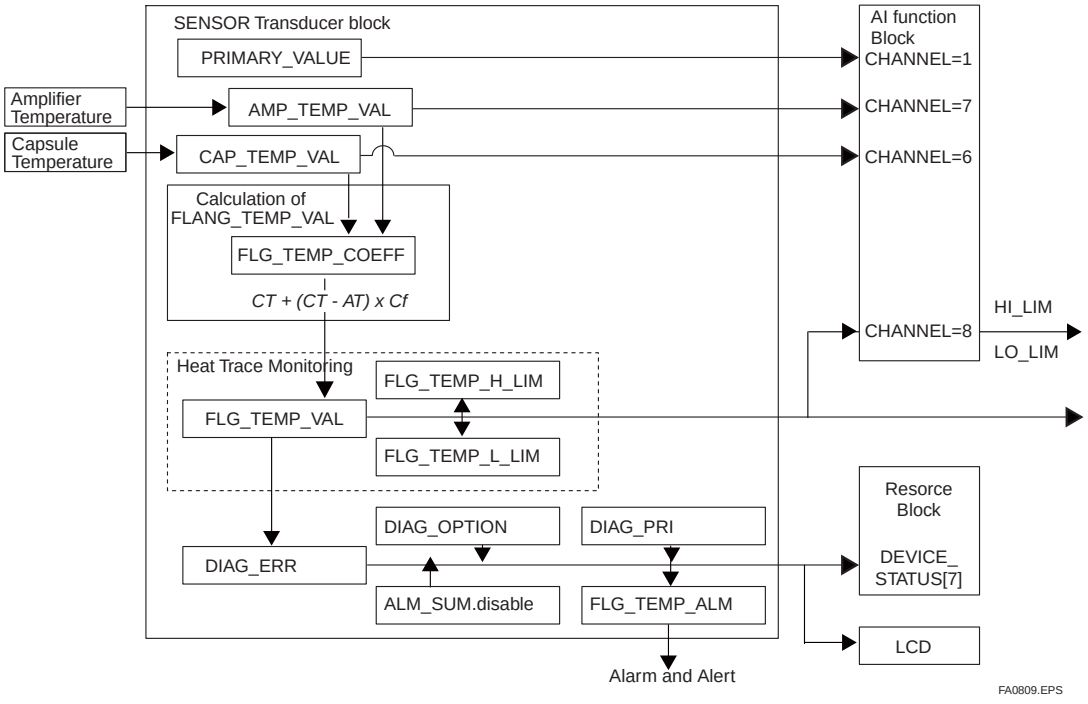

Figure A8.8 Functional Block Diagram of Heat Trace Monitoring

A8.3.2 Alert and Alarm Setting

The abnormal results of flange temperature (heat trace monitoring) are given by an alert or the LCD display of alarm status.

The flange temperature changes when the heat trace breaks or the abnormal temperature is detected due to the failure.

The abnormal results are stored in the bit 13 and 14 of DIAG_ERR in the SENSOR Transducer Block when the flange temperature is out of the range between the limits preset to the following parameters.

- FLG_TEMP_H_LIM
- FLG_TEMP_L_LIM

Generating an alarm or alert is set by DIAG_OPTION. Refer to A8.2.5 for the detail.

A8.3.3 Assignment of FLG_TEMP_VAL to Process Value (PV) in AI function block

The EJX has five AI function blocks which of each has one channel. If set 8 to the channel of AI function block, the FLG_TEMP_VAL is assigned to Process Value (PV) in AI function block. The unit of the flange temperature follows the setting of XD_SCALE in the assigned AI function block.

To Assign CAP_TEMP_VAL or AMP_TEMP_VAL to Process Value (PV) in AI function block, set 6 or 7 to the channel of AI function block.

A8.3.4 Analog Alert

Since Flange temperature is assigned to an AI Function Block, an analog alert can be generated by OUT_D in AI Block.

For the detail of the analog alert setting, refer to 6.6.5.

A8.3.5 Out of Temperature Measurement Range

If the measurement value of the capsule temperature or the amplifier temperature is out of the measurement range, the OUT signal status of PRIMARY_VALUE, SECONDARY_VALUE, and TERTIARY_VALUE becomes “Uncertain-Subnormal" and the status of CAP_TEMP_VAL, AMP_TEMP_VAL, and FLG_TEMP_VAL become “Uncertain-Sensor Conversion not Accurate”.

The measurement range of the capsule temperature and the amplifier temperature is as follows.

- Amplifier temperature: -40 to 85°C
- Capsule temperature: -40 to 120°C

The out of range is detected by the margin of 10°C added with the measurement range.

A8.3.6 Status Error

There are three statuses of “GOOD”, “UNCERTAIN”, and “BAD” for the status of FLG_TEMP_VAL.

The factor that becomes GOOD/UNCERTAIN/BAD is as follows.

Good: Normal status

Uncertain: Capsule or Amplifier temperature is out of range.

Bad:
- Capsule or Amplifier temperature sensor failure
- Capsule or Amplifier EEPROM failure
- Resource block or SENSOR Transducer block is in O/S mode.

A8.3.7 Parameter Lists for Heat Trace Monitoring function

All the parameters for Heat Trace Monitoring function belong to the SENSOR Transducer block.

Relative Index	Index	Parameter Name	Factory Default	Write Mode	Explanation
47	2047	CAP_TEMP_VAL		–	Measured capsule temperature value and status.
48	2048	CAP_TEMP_RANGE	-50. 0 to 130.0°C	–	High and low range limit values, engineering units, decimal point place for capsule temperature.
49	2049	AMP_TEMP_VAL		–	Measured Amplifier temperature value and status.
50	2050	AMP_TEMP_RANGE	-50. 0 to 95.0°C	–	High and low range limit values, engineering units, decimal point place for Amplifier temperature.
114	2114	FLG_TEMP_VAL	(Note)	–	Calculated flange temperature valueand status.
115	2115	FLG_TEMP_RANGE	-50. 0 to 130.0°C	–	High and low range limit values, engineering units, decimal point place for flange temperature.
116	2116	FLG_TEMP_COEFF	0	AUTO	Coefficient to calculate flange temperature.
117	2117	FLG_TEMP_PRI	1	AUTO	Priority of the flange temperature alarm. (Not used)
118	2118	FLG_TEMP_H_LIM	130	AUTO	Threshold to generate Flg Temp High Alarm.
119	2119	FLG_TEMP_L_LIM	-50	AUTO	Threshold to generate Flg Temp Low Alarm.
120	2120	FLG_TEMP_ALM		–	Status of flange temperature alarm.

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Note: The factory default of FLG_TEMP_COEF is 0 so the factory default of FLG_TEMP_VAL indicates the same value as that of CAP_TEMP_VAL.

REVISION RECORD

Title: Model EJX910A and EJX930A Fieldbus Communication Type
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Edition	Date	Page	Revised Item
1st	Jun. 2006	–	New publication
2nd	Sep. 2006	–	Correct errors.
		9-14	Add '9.6 Parameter Names Cross Reference.'
3rd	Feb. 2008	2-1 through 2-7	2.1 Add applicable standard and certificate number for each approval.
		2-4 through 2-6	2.1.3 Add ATEX intrinsically safe type (/KS25).
		2-6	2.1.3 Revise information for ATEX flameproof type.
		2-7	2.1.4 Add IECEx Flameproof type (/SF2).
		10-2	10.3 Add /KS25 and /SF2. Remove /KF2 and add /KF21.
4th	Aug. 2008	2-2	2.1.1 Add FM intrinsically safe and Nonincendive type (/FS15).
		2-4	2.1.2 Revise certificate number of CSA explosion proof type (/CF1).
		10-2	10.3 Add /FS15.
		10-3	10.3 Add the description of Process Sealing Certification to /CF1.
5th	Mar. 2009		Add model EJX930A
		A-69 through A-93	APPENDIX8. Add Advanced diagnostic function
		5-8 through 5-11	5.5 Add advanced diagnostic and LCD transducer block parameters
		8-3	8.2 Add status regarding Advanced diagnostic
		8-7	8.2 Add alarms regarding Advanced diagnostic
		9-6 and 9-7	9.2 Add Advanced diagnostic parameters
		9-12 through 9-14	9.4 Add LCD transducer block parameters
6th	Aug. 2009	–	Miscellaneous corrections.

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